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USSR Report

MACHINE TOOLS AND METALWORKING EQUIPMENT

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USSR REPORT

MACHINE TOOLS AND METALWORKING EQUIPMENT

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GOSPLAN OFFICIAL ON MACHINE TOOL INDUSTRY'S PRIORITIES

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 9, Sep 86 pp 16-27

[Article by B. Martynov of the USSR Gosplan Science Department: "Development of the Nation's Machine Building Complex"]

[Text] The 27th CPSU Congress, the June (1985) CPSU Central Committee Meeting on questions of accelerating scientific and technical progress and the June (1986) decree of the CPSU Central Committee Plenum placed the highest possible responsibility on the machine building industry. This sector has a primary and critical role in bringing about the scientific and technological revolution. The task to be carried out by the machine building industry in the current five-year plan and in the future is the mass production of new generations of equipment capable of repeatedly increasing labor productivity and opening the path toward automation of all stages of manufacturing.

The party and government have planned the course toward a fundamental transformation of the sector, improvement of the machine building industry's management and structure and total conversion of enterprises and production associations to new management methods.

To further improve control over the machine building complex the Bureau for Machine Building has been formed as a permanent agency of the USSR Council of Ministers. In combination with the USSR Gosplan's Administration for Consolidated Machine Tool Industry Planning, the USSR Gossnab's Administrations for the Supply and Rational Utilization of Material Resources in Machine Building and the State Committee for Science and Technology's Machine Building Main Administration, it forms a unified system for managing the machine building complex. New general management plans and organizational structures have been approved in all machine building ministries to increase control timeliness and effectiveness, provide for a future increase in association and enterprise autonomy and shift to economical management methods. In the most important areas of scientific and technological progress (this primarily involves machine building products as catalysts of scientific and technological progress), 18 interbranch scientific technical complexes (MNTK) are formulating uniform five-year and annual plans for the performance of research, development and prototyping work in the creation of highly efficient types of equipment, technologies and materials for widespread introduction in other sectors of the national economy.

THE MEASURES TAKEN AND MACHINE BUILDING POTENTIAL CREATED BY THE START OF THE 12th FIVE-YEAR PLAN ARE PERMITTING ACCELERATED RENEWAL OF MANUFACTURING ASSETS AS WELL AS THE RE-EQUIPPING AND RENOVATION OF THE NATIONAL ECONOMY AND ITS INTENSIFICATION ON THE BASIS OF NEW EQUIPMENT AND TECHNOLOGIES. It is enough to say that the specialized capabilities of the machine building industry are allowing it to produce an annual output of nearly 100 billion rubles. In the past five-year plan the sector's fundamental industrial and manufacturing assets grew 1.4-fold; this includes a near doubling of those of the Ministry of Machine Building for Animal Husbandry and Fodder Production and a 73% increase in Ministry of Power Machine Building assets. Nearly 700 major scientific research and design organizations, with nearly 400 thousand personnel, are at work within scientific production associations or independently. Every year they create more than 2200 examples of new types of equipment.

In accordance with the 27th CPSU Congress' calls for increasing enterprise and association initiative and activity which grant them broad powers for independent solution of manufacturing, management and social issues, measures have been taken to simplify the structure and system of five-year plan indicators which guide enterprises and associations toward the use of efficient economic management principles and all-out acceleration of the incorporation of scientific and technological achievements. First a new plan section was created: the Machine Building Complex. THE LIST OF APPROVED INDICATORS AND TASKS HAS BEEN DRASTICALLY CUT. In particular the number of tasks relating to full-scale production alone have been cut by 60%. The role of economic indicators and standards, such as net price, industrial production personnel wage fund increase, material incentives and production development, etc., has been increased. They are confirmed for a five-year period within a five-year plan and are not subject to revision.

The principal features of the 12th Five-Year Plan are expressed in a number of areas.

Domestic machine production is leading that of industry as a whole. But while the lead was over 20% in the 9th Five-Year Plan, it was 11.5% in the 10th and 5.5% in the 11th. In 1983 the pace of machine building output grew by 4.5% while industrial output was up by 4.2% and the total lead was down to 0.3%. The closing of machine building and industrial output rates caused a number of negative economic effects. The rate of productivity increase slowed, manual labor remained at a high level, material and energy consumption remained unjustifiably high in national revenue and the pace of existing equipment renewal and modernization was inadequate, causing the deterioration of basic assets.

Reporting to the June (1986) Plenum of the CPSU Central Committee, M.S. Gorbachev noted that, "We consider that the main components of the work to be done to bring about the party's economic strategy directly involve reorientation of the investment and structural policy: increasing the share ofcapital outlays for reconstructing and re-equipping existing enterprises, rapidly developing machine building and shortening the investment cycle."*

The goals for the 12th Five-Year Plan provide for a 1.7-fold increase in the rate of machine building productivity growth compared to the 11th Five-Year Plan. The productivity growth planned for 1990 is 143%, 18% higher than the rate for industrial manufacturing as a whole. The fundamental significance of this is obvious. This type of lead provides the possibility of renewing basic assets and significantly expanding (nearly doubling) the use of progressive technologies and increasing the level of automation in manufacturing.

During the 8th and 9th five-year plans high rates of production growth in the sector were achieved by means of a substantial gain in the number of employees and the consumption of rolled ferrous metal products. In the 12th Five-Year Plan THERE WILL BE NO PRACTICALLY NO INCREASE IN THE NUMBER OF PRODUCTION PERSONNEL OR IN THE CONSUMPTION OF ROLLED PRODUCTS (see the Table).

The accelerated pace of production growth must be achieved primarily by increasing the technical level of production, changing its structure through the manufacture of progressive types of machines, equipment and devices, and extending the scope of component, unit and process specialization. This is the way to qualitatively new machine building production output growth rates.

TABLE (values are percentages)

Indicator	Five-Year Plan				
	8th	9th	10th	11th	12th
Production volume	160.3	163.3	135.9	125.4	143.0
Number of employees	113.7	110.4	105.9	102.2	100.6
Rolled product requirement	128.0	120.0	105.1	103.6	100.0

Again the machine building complex is faced with A TASK IN THE AREA OF PRODUCT TECHNICAL STANDARD AND QUALITY. In 1985 only 39.2% of machine building output was in the highest quality category. Change in this area is unacceptably slow. The evaluation of product technical standard and quality systematically carried out by the State Committee on Science and Technology and the USSR State Committee for Standards shows that there are major shortcomings in solving these problems. At times there is a lack of adequate information on the technical standard of similar foreign models, not every main scientific research institute and design bureau in the sector is performing the requisite standard of work in the area of long-term scientific and technological progress forecasting, in many cases the equipment found at these organizations does not satisfy even minimal demands and the board accrediting scientific research institute and design bureau personnel often approaches its critical assignment in a formalistic manner so, as a result, personnel qualifications are not adequate for the high level of equipment being developed.

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* "Materialy Plenuma Tsentralnogo Komiteta KPSS" [Materials on the CPSU Central Committee Plenum], 16 June 1986, Moscow, Politizdat, 1986, p 16.

The technical and economic parameters of many types of equipment do not satisfy current requirements. The technical standard of such major types of

machine building products as internal combustion engines, systems for automated machine, equipment and instrument control and a number of machines used in light industry, the food industry, construction and agriculture is quite low. The quality situation of many systems and units such as pumps, compressors, reduction systems and hydraulic units is not good.

The May (1986) meeting of the CPSU Central Committee on the issues of future development of machine building sectors and increasing the technical standard and quality of its output placed special emphasis on the fact that machine building ministry, association and enterprise leaders, scientists and specialists must perform a fundamentally important step, that of bringing domestic industry to a position of worldwide leadership, in a very short time. There is a great deal of work to be done in this five-year plan to bring about this important area of machine building complex development.

This task gives rise to the need for maximum acceleration of the pace at which achievements of scientific and technological progress are implemented in practice. In particular, the 12th Five-Year Plan calls for a 3 to 4-fold reduction in product output renewal, a sharp increase in the quality and technical standard of scientific and design projects and a no less than 3-fold reduction in testing and development times for new equipment models, as well as a reduction in production startup and industrial incorporation times. The five-year plan provides the necessary assignments, measures and resources for this work.

MICROELECTRONICS is opening fundamentally new possibilities for automating machine and equipment control and improving their efficiency. It is expanding the functions of machines and equipment, repeatedly increasing their reliability, reducing energy consumption and dimensions and supporting movement toward the limits of technology.

The progress of domestic equipment is being held back by inadequate use of electronic control measures, especially microprocessors. This problem has only been addressed in instrument making and machine tool building. As a result, the proportion of machines, equipment and instruments fitted with electronic control systems and microprocessors will not exceed 5% of the total machine building product output. During 1986-1990 this most important area of scientific and technological progress will be implemented on a vast scale.

The task is to bring the relative proportion of the most important types of machines, equipment and instruments fitted with electronic control systems, including microprocessors, to no less than 30% of the total volume of chemical and thermoelectrical equipment, forging and foundry machinery, light vehicles, combine harvesters and tunneling equipment; to 40-50% of electrical measuring instrumentation and systems for automating control and engineering work, excavators, truck cranes, loaders and motor graders, passenger elevators, equipment for chemical fiber production and equipment for light industry as well as the food, meat, dairy and fishing industries; and to 60-80% of steam, fuel and gas turbines, diesels and diesel generators, computer equipment, tractors, combines and mineral fertilizer transporters and printing industry equipment.

On the whole, the machine building industry's proportion of machines, equipment and instruments equipped with electronic control and diagnostic systems to increase to 30-50% while the proportion in instrument making, power engineering and agricultural machine building is to rise to 60-70%. This will provide a capability for sharply increasing equipment technical standard, quality and service life while reducing relative material and energy usage.

The five-year plan's measures for advanced development of the instrument making industry will allow at least a doubling of the production automation level. This will primarily involve fuel/energy, machine building and agroindustrial complexes, as well as the metallurgical, chemical and other sectors. Overall deliveries of plant process control automation system hardware and software are increasing more than 10-fold, primarily for nuclear power plants and petroleum/gas fields in Western Siberia, as well as for metallurgical facilities.

Production of instruments for scientific research (electron microscopes, mass spectrometers, chromatographs, measurement and calculation units for scientific experiment automation and other devices) will more than double.

There will be a significant increase in the output of automated design equipment based on new computers with 5-10 times more productivity, expanded memory and increased reliability. This will form the basis for improving engineering equipment and re-equipping design bureaus, institutes and prototype production facilities to provide the needed level of technology and a reduction of research and development lead times.

Analysis shows that some machines, equipment and instruments do not satisfy current reliability and capability requirements. This is causing major operational delays. The tremendous expenses needed for equipment repair are especially unjustified. At the June (1986) meeting of the CPSU Central Committee it was pointed out that 10 billion rubles are spent on the equipment repair industry alone and more than 3 billion rubles of this amount is needed to repair equipment that is operating beyond its specified service life. Up to 20% of the rolled ferrous metal used in machine building goes to the production of spare parts. For example, the amount of rolled product needed to produce tractor and light truck spare parts is 40-50% of the quantity used to manufacture the tractors and light trucks themselves. Finally, poor machine, equipment and instrument service life reliability is responsible for the high and economically unjustified demand for these same products.

At this time the "Nadezhnost" [Reliability] MNTK has developed a program to quickly eliminate current shortcomings in these areas. Implementation of the program will permit a 2 to 5-fold increase in the service life and reliability of most types of equipment produced by the domestic machine building industry. Specifics include a planned 1.5 to 2-fold increase in the first major overhaul interval of ZIL and GAZ vehicles, most types of tractors, high-speed diesel engines, tunneling machine systems, bulldozers, continuous-weave looms, vacuum evaporation units for the sugar industry, etc.

The widespread introduction of progressive hardening methods will play a special part in eliminating this problem. These include gas-thermal spraying of alloy coatings on machine components, ion-plasma, ion, electron beam, laser fusion and other methods. The volume of components manufactured and rebuilt with hardening coatings will more than double in this five-year plan. The balances and plans for distribution envision a reduction of demand for these types of machines and spare parts.

The 12th Five-Year Plan calls for expanded PRODUCTION OF NEW GENERATIONS OF EQUIPMENT. More than 8000 automated rotary and rotary-conveyor lines are planned for machine building and other sectors of the national economy. These will permit a 5 to 10-fold increase in labor productivity, a 3 to 4-fold reduction in manufacturing equipment space requirements and a 15-fold decrease in the number of hauling operations.

There are plans for increasing the output of multi-purpose machines which will increase labor productivity by 3 to 5-fold. These machines will be made for machine tool building as well as construction and road, mining and agricultural machine building. Production of the multi-purpose machining center type of machine tools will increase from 2400 units in 1985 to 10,700 units in 1990. Nearly 30 thousand of these machine tools will be manufactured during the entire five-year plan. The construction and road machine building industry will produce 2000 compact, general-purpose TO-31 earthmovers. They will be equipped with 12 types of removable implements for jobs such as loading and dumping, drilling, trenching, snow removal, ice breaking, street cleaning, etc. During the five-year plan the heavy machine building industry will produce 125 KOV-25 systems for mining steeply sloped veins of nonferrous metals. These systems will support work in resistant rock, borehole ring drilling, installation of a process monorail and explosive network, borehole blow-out and reaming, as well as personnel, material and instrumentation transport and rescue work. Use of the systems will allow elimination of the traditional method of mining these areas based on extensive use of manual labor under dangerous conditions.

The 12th Five-Year Plan will see the start of production of other types of multi-purpose equipment. These include machines for repairing and maintaining railroad tracks, constructing and maintaining highways, combined soil preparation prior to planting and local-conveyor application of full mineral fertilizer doses combined with simultaneous soil preparation for soy beans and other crops.

Statistics indicate that during each five-year plan there is an average cumulative productivity increase of 20-60% in the equipment the machine building industry produces for agriculture, mineral processing, ferrous and nonferrous metallurgy, petroleum extraction and petrochemicals production. However, because the equipment base is being supplemented with such equipment at a relatively low rate the increase in the existing base's technical standard will fall behind the demands imposed by the 27th CPSU Congress.

At the very start of the five-year plan each machine building ministry and sector scientific research institute and design bureau is faced with the tasks of sharply expanding work in the creation of equipment which will provide a

large increase in labor productivity, drawing on the reserve of fundamental and applied data developed by organizations such as the UkSSR Academy of Sciences, BeSSR Academy of Sciences and USSR Academy of Sciences' Siberian Department, making extensive use of current advances achieved in the defense sectors of industry and in CEMA countries and, if necessary, acquiring licenses for equipment production and process incorporation.

A significant increase is planned in the volume of INTEGRATED PROCESS EQUIPMENT deliveries to the national economy. The number of products of such equipment and lines will grow to approximately 540 items, or 2.5 times that of the previous five-year plan. Integrated process equipment's share of the total output of this type of product will increase to 20-50% in comparison to 5-11% in the last five-year plan.

Special attention has been devoted to the creation, production and delivery of automated modular compressor stations for gas extraction operations at petroleum boreholes, gas transport systems, integrated petroleum and gas processing units, modular equipment for gas pipelines, hydraulic piston pumps, etc. Deliveries of this equipment to the petroleum and gas industry will increase to 810 million rubles in 1990, four times the 1985 level. The high level of factory assembly work will allow a 1.5 to 2-fold decrease in set-up times at field and pipeline facilities. This will be especially important to West Siberian Oil and Gas Complex enterprises.

In order to better satisfy the national economy's demand for advanced types of machines, equipment and instruments, the five-year plan provides for SIGNIFICANT STRUCTURAL CHANGES IN MACHINE BUILDING PRODUCTION OUTPUT. For example, in 1985 the proportion of advanced types of metal-cutting machines was 43%, in 1990 it will grow to 85%. For other items the respective figures are: 30% and 68% for automated forge and press equipment; 4.8% and 73% for the new AI series of electric motors used in a wide variety of applications; 28% and 54% for transport vehicles operating on diesel fuel, compressed gas and liquified gas; 39% and 67.6% for highly expandable drilling rigs; and 23.6% and 42% for tractors of 100 HP and over. The Ministry of the Electrical Equipment Industry's production of a new series of standardized turbogenerators is increasing 6.4-fold and their share of total generator production will rise from 19.6% in 1985 to 58% in 1990. The machine building and metal machining industries' requirements for centrally produced tools with wear-resistant coatings will be fully satisfied.

The chemical and petroleum machine building industry plans a 1.4-fold increase (from 562 thousand to 783 thousand units) in the output of the most productive pin-type chisels, which in 1990 will make up 67% of total rotary bit production. The time between repairs of deep-well, sucker-rod pumps will increase from 250 to 400 days. The proportion of looms incorporating new weft fiber placement principles will reach 84% in 1990.

Large quantities of new and innovative equipment will be produced for fuel/energy and agroindustrial complexes and to industrialize construction, transport, ferrous and nonferrous metallurgy, the chemical industry, light industry and other sectors.

Power engineering machine construction will provide highly efficient equipment for nuclear power plants and will allow more widespread use of atomic fuel for power production and heat generation. There will be an increase in the delivery of equipment designed to use atomic fuel for heat generation and a number of heat-generation stations will be built in various regions of the country.

A new major step will take place in the creation of highly automated, 25-MW gas transmission systems for main pipelines. They will require less gas, have a 35% efficiency factor and will be 2.5 times lighter. Our gas industry is waiting for these economical and highly efficient machines.

Petroleum interests will be receiving a new generation of drilling machines which have a higher degree of factory assembly and will appear in twice the number and with twice the efficiency of models from the last five-year plan.

In the 12th Five-Year Plan nearly all agricultural machinery plants will change to the production of new generations of equipment. This equipment must allow all field work to be carried out on the basis of intensified and industrialized cultivations processes, cut operating expenses by 30-40% and save more than 1 million tons of fuel. This production output is to be obtained without increasing the number of workers (more than 3 million persons) that were needed to conduct this work at the 11th Five-Year Plan's level. Full-scale production of more than 350 new and modernized machines is planned. These include highly productive grain harvesting combines, wide-cut self-propelled harvesters, potato and beet harvesters, systems for preparing and applying mineral fertilizers and crop protection chemicals, grain and seed grass threshers and many others.

By the end of this five-year plan over 1000 product lines (compared to 800 in the 11th Five-Year Plan) will have been produced by the plant cultivation agricultural machine building industry. This will allow completion of the process of basic overall cultivation automation in fundamental agricultural cultivation operations.

For labor process mechanization at animal-breeding farms and feed preparation facilities there are plans for the creation and production of 220 new types of machines and equipment. These will form the basis for 147 manufacturing systems and final product lines. It is estimated this will free 400 thousand workers, lower labor expenses in the production of milk, meat and other animal products by 15-30%.

Compared to 1985, the production of manufacturing equipment for the food industry sectors will increase by 64%. Series production of a fundamentally new type of equipment based on the highly efficient membrane technology will begin. This will include machines for processing secondary dairy products, fruit juices, dry wines and fish broths.

A further broad shift to the creation and manufacture of new and progressive machines as a components for systems and complexes is planned for the construction industry. Plans call for the development and production of 335 new types, production of 506 prototypes, series production of 509 and

modernization of 572 types of machines and equipment. As an example, with this there will be a 42% increase in average scraper productivity, a 1.4-fold increase in the average bulldozer traction rating and similar increases in the productivity of other machines. This will enable overall mechanization of manufacturing processes, a significant increase in the technical standard and a sharp reduction of manual labor in production for construction and reclamation interests.

The annual national economic impact of using the new equipment developed by the Ministry of Construction and Road Machine Building during the 12th Five-Year Plan will be nearly 2 billion rubles.

The entire system of equipment which will enter the national economy during the 12th Five-Year Plan will provide a fuel and energy savings of some 140-150 million tons of conventional fuel, including:

> Over 80 million tons in power engineering as a result of using atomic energy units, hydroelectric power and increasing equipment efficiency.
>
> Over 9 million tons through the use of synchronous compensators, cosine power capacitors and fluorescent lights in the power grid.
>
> Over 5 million tons in road transport and agriculture through the use of trucks, tractors, combines and other agricultural machinery with economical power plants with fuel consumption rates 7-12% lower than those of previous equipment.
>
> Over 3 million tons by using high-volume systems for the production of ammonia, methanol and protein and vitamin concentrates, as well as other types of equipment from the chemical machinery building industry.

Moreover, nearly 10-12 million workers will be freed, including nearly 4 million in agriculture; 4-5 million in light industry, the food, meat and dairy industries, trade and public services; and 2.5 million in other branches of industry.

Of course, the machine building industry has never before faced tasks of this urgency and complexity or conditions such as those set up in the 12th Five-Year Plan. The June (1985) CPSU Central Committee Meeting on questions of accelerating scientific and technological progress has focused the attention of planning agencies, management leaders and scientists on this industry as our economy's key element for the practical implementation of advanced scientific and technological achievements and the re-equipping of the nation's economic potential. Capital outlays nearly equal to the resources of the two prior five-year plans have been allocated for machine building development.

The sector's output increase alone during this five-year plan will exceed 1985's production by 1.6 times. All products which are subject to certification must be produced ONLY AT THE HIGHEST QUALITY CATEGORY LEVEL while meeting stricter technical and economic parameter requirements. These tasks are quite extensive and quite complex for many collectives.

Under these conditions special attention is being devoted to rapidly and efficiently solving internal problems in developing the entire set of machine building sectors. One of these is a SHARP REDUCTION (to 5-7 years) OF LEAD TIMES for product line renewal. First of all the very nature of new machine development and testing must be changed. The testing and development of new equipment models at a series of design bureaus and prototype production facilities at each level is 10-15 years behind modern requirements. There is a need for serious development and re-equipping of prototyping shops and production engineering services.

Many collectives have long been actively working on the solution of such problems. Work in this area must be intensified many times over during this five-year plan. The assignments of national and sector plans, as well as the plans of enterprises, scientific research and design organizations are directed to this very end. The pace of worker labor and production process preparation automation is steadily increasing and a system is being created to automate development, testing, production preparation and widespread introduction of new and innovative types of equipment and technologies. At the same time, at a number of enterprises this work is still being carried out in a sluggish manner, managers are not making efforts to introduce means of automation, the reorganization of concepts held by some designers and production engineers is still delayed and production equipment as well as estimation and control systems are still out of date.

Attention is not being paid to the creation of shared-usage centers for ASPR [Automated Planning Calculation Control] systems and to standard programs for different factories within a single sector or programs arranged according to uniform product types in various machine building industry sectors.

The creation of high-quality products, especially for mass production, requires a sharp increase in testing confidence. Modern test stands permit integrated processing of parameters and working conditions to be faced by the new product. In fact, this can be the only basis for assuring a high standard for machines before they are turned over to mass production. To this end, machine building industry personnel are directing efforts toward speeding the development of PROTOTYPE DEVELOPMENT BASES and the creation and introduction of modern equipment stands and test areas. Experience shows that not less than 8-10% of the resources allocated to re-equipping and capital construction should be devoted to this. At the same time, not all enterprise and organization leaders are taking measures to carry out this important task in the shortest time possible. This error can lead to failures in fulfilling the goals of increasing the output product technological standard.

There must be a definite intensification and development of tool and accessory production shops, as well as rapid distribution of the modern equipment needed to produce these items. In the 12th Five-Year Plan the capacity of these shops and facilities must exceed the current level by 2.5 times.

A sharp increase in the production of special manufacturing equipment particular needs, especially precision machine tool building, is a most important problem in re-equipping the machine building complex. The plan calls

for an approx. 5-fold increase in the production of this equipment during the five-year period.

There are many possibilities for carrying this out. For example, the preparation of complex automated lines for foundry work has been organized in the Ministry of the Automotive Industry. Their standard is higher than that of equipment produced by the Ministry of Machine Tool Building although the latter is the leader in that field.

In 1986-1990 this urgently needed equipment must be produced at a 12-billion ruble volume. It is very important that everything be done to carry out this task. According to USSR Gosplan estimates, some 2.5 billion rubles must be invested in developing the basis for this production. In spite of any difficulties these funds must be allocated, and effectively used, by the ministries. In many cases it may be necessary to reconfigure some basic production capabilities. We cannot agree with the position of some ministries who continue to look toward imports as the means of solving these problems. For example, the Ministry of Tractor and Agricultural Machine Building is asking for imported machinery purchases totalling more than 1 billion rubles during the 12th Five-Year Plan, although a significant part could be produced by domestic enterprises, including some of the ministry's own.

In contrast to previous five-year plans, the 12th provides a number of measures involving a significant increase in the level of technology in machine building production, especially the widespread introduction of the most progressive fundamental processes. The primary thrust here is the introduction of over 2000 flexible manufacturing systems where a maximum effect can be obtained, especially in priority machine building sectors such as the Ministry of Machine Tool Building, Ministry of Instrument Making, Automation Equipment and Control Systems and the Ministry of the Electrical Equipment Industry, as well as the ministries of the Automotive Industry and Tractor and Agricultural Machine Building which have high levels of metal machining.

Over 30 thousand of the 86 thousand industrial robots scheduled for introduction in national economy sectors during the five-year plan are designed for the automation of mechanical assembly, stamping, welding and painting operations in civilian machine building sectors. In 1990 deliveries of numerical control machine tools will reach 128,700 units. The five-year plan includes the introduction of over 30 thousand machining centers. The introduction of machine tool, press and forge, rotary and rotary conveyor automated lines in 1990 will be 3 times the 1985 level. These and other progressive types of equipment introduced in machine building will permit a definite change in the structure of the installed equipment base by 1990. Up to 80% of mechanical component machining in fundamental production operations will take place on automated equipment.

Yet another fundamental question common to all machine building industry sectors should be examined. This is the development of BLANK MANUFACTURING FACILITIES. Raising their technical standard is a major social and economic problem whose solution must be accelerated to a maximum. It is known that many blank production shops have poor working conditions and low equipment

technology levels. The extent of automation in a number of process stages does not exceed 3-5% and losses due to waste are high. Poor blank quality leads to unjustified losses in material and labor resources and complicates machine design.

Because the situation becomes more acute each year there needs to be a more intense effort to introduce progressive technologies, sharply raise the level of automation and generally improve working conditions in blank production facilities. USSR Gosplan estimates indicate that the proportion of blanks manufactured by means of progressive technology must be raised to no less than 70% during this five-year plan. More than 14% of the capital investment allocated to machine building industry sectors must be devoted to this end.

Among these new technologies are the production of metal powder products which is planned to increase more than 6-fold and component rolling technology whose level of introduction is to rise 2.3-fold and reach 270 thousand tons in 1990. Welded metal structure output is to rise by 2.3 million tons during the five-year plan and reach 15 million tons in 1990. In this production there will be a sharp increase in the use of low-alloy steels, double-layer metals, light alloys and simplified metal shapes. Computer-assisted methods for optimal metal shaping on thermal cutting and other machines will be widely used.

Fundamentally new basic technologies will be used and further developed in machine building. Examples of these include: electron beam, laser, pulse membrane, super-high pressure, self-propagating high-temperature synthesis and other technologies which provide material resource savings. In all, the planned introduction of progressive equipment and technologies will permit an increase in machine and mechanism service life and reliability, lower their specific metal requirement and increase the coefficient of metal production usage.

Let us examine one more problem whose solution is being speeded in the 12th Five-Year plan and which will become the basis for making machine building a single national complex capable of quickly supplying the amount of innovative equipment needed to reconstruct the national economy. This involves all types of specializations and rapid rates of development in the manufacture of products OF GENERAL USE IN THE MACHINE BUILDING INDUSTRY are of special concern.

The structure of domestic machine building, primarily based on a principle of the universality and completeness of enterprises working in a closed technological cycle, does not satisfy current demands for scientific and technological progress and impedes sector technology improvement. An inadequate level of concentration on the manufacture of uniform (from the point of view of design and technology) products for general use in machine building forces plants to produce these items in less than optimum quantities with increased labor and material expenditures and low quality. The level of intersector cooperation does not exceed 1% for intermediate products or 3% for subassemblies and components. An example of the lack of concentration and efficiency in uniform products is that the efforts of 63% of the machine building industry enterprises producing ferrous and steel castings amount to

9% of the total volume. These figures reveal economically unjustified expenditures of labor, materials and energy.

A marked expansion of component technology specialization and production cooperation are planned during the 12th Five-Year Plan to effectively link mechanical assembly enterprises with factories specializing in the production of standardized assemblies and components for general use in the machine building industry. Commercial delivery of these assemblies and components must increase 3.5-fold. The list of products for general use in the machine building industry will be expanded. In addition to an increase in traditional product output (such as hydraulic and pneumatic equipment, standardized reduction units and laminated chains), there must be production of bearings, various types of covers, collars, pulleys, shafts, blocks and flywheels, connecting components for machine building conduits, springs, cables, ball bearings and many other assemblies and components generally used in machine building.

The machine building ministries' responsibility for production and delivery of general-use products has been increased. Now not only the Ministry of Machine Tool Building but 8 of the 11 machine building ministries have been named as leaders. Each is responsible for the technical standard and requirement satisfaction of a certain number of products of general use in machine building. The implementation of measures intended to develop specialization will permit a marked increase in machine building labor productivity and, most importantly, an increase in product quality and reliability due to a stable supply of assemblies and components, an overall approach to production process development and extensive testing under various conditions.

The five-year plan's goals will permit significant progress in specialization questions. Further development of assembly and component specialization is to take place through the efforts of the main machine building industry ministries responsible for the high technical standard and quality, as well as satisfaction of the demand for products for use throughout the machine building industry. The 12th Five-Year Plan calls for increasing the production of general machine building industry products at specialized enterprises from a 1985 level of 1.1 billion rubles to 3.45 billion rubles in 1990, a 3.1-fold increase. The basic product line will expand from 8 to 26 items. Just the implementation of measures to develop production specialization alone will allow labor productivity during the 12th Five-Year Plan to be raised by 12-15% in machine building and by 20-30% in blank manufacture, forging expenses per 1 million rubles of commercial production to be lowered by 22-25% and wastage to be reduced by 50-60%. All this will in turn reduce production delays.

The introduction of scientific and technological achievements in the machine building industry and the organizational improvement of production and control will increase the complex's efficiency level in the following ways: labor productivity will grow by 44.6% producing 99% of the production output increase; the proportion of manual labor will fall from 30% in 1985 to 20.9% in 1990 allowing no less than 428 thousand manual laborers to be freed during the five-year period; expenditures per ruble of commercial production will drop by 10.4 billion rubles over the five-year period and enterprise and association earnings will be 2.1 times those of 1985; and rolled metal product

usage per million rubles of commercial production will be reduced by 29.5% to the 1985 level providing an estimated savings in 1990 of over 6.3 million tons.

The tasks placed before the machine building industry by the party and the government and the major assignments of the five-year plan require steady and harmonious work by all subunits, as well as high efficiency on the part of these latter. The search for innovation, initiative and the responsibility every machine building industry worker has for a high standard of development, quality construction of every assembly and component and for consistent efforts to master advanced equipment and new machine building production methods, provide a reliable assurance of a fundamental transformation in the nation's machine building complex and of a major contribution to accelerating the shift of economics to fast-track development and increasing the efficiency of all manufacturing in this country.

12746
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PUSH TO DEVELOP MACHINE BUILDING MORE RAPIDLY

Moscow AGITATOR in Russian No 17, Sep 86

[Article by G. Stroganov, Doctor of the Technical Sciences and Deputy Chairman of USSR Gosplan: "The Machine-Building Industry Must be Developed More Rapidly"]

[Text] To be the foundation, the catalyst of progress, and the crucial link for the new era of industrial modernization in the national economy -- such is the role entrusted to the machine-building industry by the party. At the June 1986 Plenary Session of the CPSU Central Committee, this industry was named as the focal point for all of the economic problems now facing the country. Unless the machine-building industry is quickly modernized and converted to the production of new types of advanced equipment and machinery for all branches of the national economy, it will be impossible to carry out the program presented by the XXVII CPSU Congress.

The domestic machine-building industry commands a great reservoir of scientific and industrial potential. It is sufficient to say that the specialized components of this industry are capable of producing more than 150 billion rubles' worth of output every year. During the preceeding five-year plan, fixed plant and equipment in this industry increased 1.4-fold. Nearly 700 major scientific-research and project-design institutes work together to develop 2.2 thousand examples of new technology annually. Production associations such as ZIL (Likhachev Automotive Plant), AvtoVAZ (Volga Automotive Plant), KamAZ (Kama Automotive Plant), Elektrosila, Uralmash, the Sumskiy machine-building scientific production association imeni M. V. Frunze, and other associations are famous all over the world.

The above notwithstanding, the current state of the machine-building industry and its base of production technology is still a long way from completely meeting the requirements of rapid economic development.

It took more than ten years to increase the portion of the total volume of machine-building output devoted to high-quality goods to 39.2 percent. Many types of machinery are inferior to those made in other countries.

This includes machine tools, forging presses, internal combustion engines, automated control systems, and many types of machinery and equipment for light industry and food processing, construction, and agriculture. The situation is especially unfortunate when it comes to the quality of components and machines that are integral parts of other machinery, such as pumps, compressors, reducers, hydraulic components, electrical power sources, products that can be used for general machine-building purposes, and other parts and components.

Projects designed for the modernization of plant and equipment are being developed and implemented slowly and with poor results, especially within the Ministry of the Machine Tool Industry and the Ministry of Electrical Engineering Industry. There have been many instances where wasteful and inefficient technologies have been incorporated into projects, resulting in an increase in manpower requirements. Moreover, obsolete jobs account for a third of the total in this industry, assuming that there are two shifts per job.

Advanced and highly efficient equipment, such as machines that can perform multiple operations, digitally-controlled machine tools, flexible modules, rotor and rotor-conveyor lines, automated design and control systems, and robotics are not being used extensively enough and are being operated at a low rate of shift utilization. According to data supplied by the People's Control Committee, highly productive processing centers at enterprises overseen by the Ministry of the Electrical Engineering Industry are not being utilized, and some of them are simply mothballed. At many enterprises supervised by the Ministry of Agricultural Machinery and the Ministry of Power Engineering Equipment, the coefficient for using the shift system on digitally-controlled machine tools is less than one. These types of practices belie the potential inherent in the latest types of machinery and inflict great economic harm on the country.

Machining is still the primary machine-building operation and results in a great quantity of metal ending up as chips and shavings. Techniques for shaping metal parts using pressure, welding, and precision casting that have long been familiar and that produce little waste are hardly being used. This also applies to waste-free technologies. Advanced technologies that form the basis of industrial production -- plasma, pulse, electron-beam, laser, and other technologies -- are not being established with sufficient vigor. Experimental centres, laboratory stations, testing sites, and experimental production facilities are poorly equipped.

The majority of machine-building plants operate according to the principle of "having everything under one roof." They have a complete line of metallurgical, machining, assembly, and auxilliary shops, which results in lower labor productivity and the over-consumption of resources. The helter-skelter production of blanks by itself makes machine-building products 1.7 billion rubles more expensive each year.

The work of individual scientific research and project design organizations also leaves room for improvement. They are awash in uninspired and poor-quality projects.

After the April 1985 Plenary Session of the CPSU Central Committee, the country embarked on a campaign to overcome these negative trends. A long-term strategy for developing the machine-building industry was defined. The party and the government passed a number of decrees which specified concrete measures for overhauling the industry.

The Bureau of the Machine-Building Industry was formed as a permanent body of the USSR Council of Ministers. Its purpose will be to provide high-quality leadership to the machine-building industry and to transform it into a highly developed industrial base capable of facilitating the rapid modernization of the national economy on a foundation of scientific and technological achievements exploited to the fullest extent.

As of now, the solutions to the major questions concerning the network of machine-building industries have been found, and the potential for further increasing the technological sophistication of the goods produced has been tapped through the faster incorporation of scientific and technological advances as well as through better managerial practices, administrative systems, and a higher level of state, plan, and executive discipline.

During the first half of 1986, the growth rate of production volume was 107.1 percent, and of labor productivity -- 107.7 percent. Therefore, it can be said that hard work is the backbone of machine building.

Machine building production volume will increase by 43 percent during the 12th five-year plan. This figure is 1.7 times greater than that projected for the industrial sector as a whole. This indicator will increase 1.5 to 1.7-fold for instrument building, machine-tool building, the production of electrical equipment and machinery, and chemical and agricultural machine building. This approach is of fundamental importance, inasmuch as it will facilitate the rapid rejuvination of the viable portion of fixed plant and equipment on a qualitatively new basis and ensure the broad utilization of advanced foundation technologies in the national economy accompanied by a 1.5- to 2-fold increase in the automation of production.

The problem of product quality and engineering has been presented in an entirely different way to those employed in the machine-building industry. This is the key to the most important and fundamental aspect of the five-year plan -- to incorporate scientific and technological progress as quickly as possible. Specifically, a 3- to 4-fold reduction in the time it takes to renew manufacturing output is envisioned. Whereas it used to take 32 years to replace machinery and equipment, by 1990, it will take seven to seven and one-half years. Advanced types of machinery and equipment will, by the same token, make up a much larger share of production. Their per-unit capacity, productivity,

reliablity, and cost savings will increase, and the amount of energy they consume and their specific materials content will drop.

It is clear that, in order to increase the rate at which machinery and equipment is replaced, it is necessary to increase the rate at which it is developed and put into production. This will be done primarily through the extensive use of automated design systems and also by building new and well-equipped facilities for testing and experimentation.

It is a well-known fact that the latest advances in the field of microelectronics opens the door to fundamentally new ways to automate the control of machines and equipment and increase their efficiency. In 1985, no more than five percent of the total volume of the best machinery, equipment, and instruments produced by the machine-building industry was equipped with electronic control and microprocessors. During the current five-year plan, this great avenue of scientific and technological progress will be developed to the greatest extent possible. It is planned to use microprocessor-based controls as a basis for increasing the indicators for reliability and service life three- to five-fold and reducing energy and materials consumption 20 to 40 percent in the instrument, machine-tool, and electrical engineering industries. In the production of automotive, agricultural, heavy industrial, and power-engineering machinery, it is planned to decrease fuel consumption 10 to 20 percent, increase productivity 20 to 50 percent, and effect a two- to three-fold increase in their reliability and service life.

While the machine-building industry makes a sharp turn towards the automation of the machinery it produces, the production of computers and instruments will be rapidly expanded and the quality of their engineering improved during this five-year plan. As production volume of instruments increases 1.7-fold and the renewal rate of output goes up 70 percent, the output of computers that perform control functions will grow 2.6-fold, and equipment for the computerized operation of machine tools and robots and control centers for automated production lines will be produced at a level 3.5 times over the previous level of output. The reliability of computerized control systems will increase three to five-fold. This will ensure the substantial growth planned (from two to 10 percent) for the manufacture of machining centers, computerized machine tools, robots, and robot-based machinery and equipment for flexible production systems, automated design systems, and microprocessors.

At the same time, the delivery of computers and software in complete sets for the automation of industrial process control, primarily at nuclear power plants, Western Siberian oil-and-gas fields, and metallurgical works, will be increased 10-fold.

There will be a 1.5-fold increase in the production of instruments used in scientific research.

A problem of particular importance is to fine-tune the mass production

of state-of-the-art machinery capable of producing a multi-fold increase in labor productivity, and to clear the way towards the automation of all phases of production. The 12th five-year plan calls for the expanded production of this type of machinery. In particular, the production of automated revolving and revolving-and-conveyor production lines will greatly increase.

It is planned to expand the production and once again develop a significant number of multi-operational machines that will increase labor productivity three- to five-fold.

Deliveries of complete sets of industrial equipment to domestic industries will also significantly increase in volume. The nomenclature of this equipment will be increased 2.5-fold, and its share of total production will grow to 20 to 40 percent compared with five to 11 percent during the previous five-year plan.

The machine-building industry will play a bigger role in the development of the energy industry. It is a well-known fact that, until recently, the machine-building industry primarily made equipment for the exploitation of new deposits, but made little equipment for increasing the yield of oil-bearing strata, refining oil efficiently, converting vehicles to diesel engines, and conserving energy in other ways. At a converence in Tyumen in 1985, some very critical remarks in this regard were made about the ministries involved in machine building, and they were told exactly what to do about it. The production of fully-equipped oil-field and drilling rigs that are highly reliable and durable must be quickly established. This will make it possible to increase the mechanization and automation of drilling oil and gas wells and to produce more oil and gas with fewer workers.

In the current five-year plan, the machine building industry is putting a lot of effort into converting motor vehicles to the use of less expensive diesel fuels. The use of diesel engines helps to decrease fuel consumption 30 to 35 percent in comparison with gasoline engines. Diesel engines also last one-and-a-half to two times as long as gas engines. Within the next few years, diesel vehicles and tractor trailers will take on a significant part of the freight turnover carried by domestic vehicular conveyance. Plans exist for learning how to produce passenger cars with diesel engines. More natural gas-powered vehicles will be made.

Makers of power engineering machinery will produce highly efficient equipment for nuclear power plants. This industry is prepared to manufacture and provide power engineers with a new nuclear reactor that is bigger and better than any other reactor in the world. There will be an increase in the deliveries of equipment that uses nuclear fuel to produce heat and power.

Makers of agricultural machinery will more quickly learn how to produce more of the type of machinery needed to overcome the uneven mechanization of agriculture. Presently, more than 100 agricultural operations,

primarily auxilliary and those entailing loading and unloading, are yet to be fully mechanized, while manufacturers have been concentrating their efforts on augmenting the production of equipment for operations that are already highly mechanized (grain harvesting, sowing operations, and so forth).

In a speech before the workers of the city of Tolyatti, comrade M. S. Gorbachev remarked that the production of agricultural machinery was prone to its own kind of "tractor bias". For many years, tractor production was pushed hard, but there was not a concommittant increase in the production of complementary machines and implements. The end result of this is that state and collective farms have at their disposal enormous fleets of tractors that they cannot use efficiently.

The current five-year plan calls for a three-fold increase in the output of a line of implements used with tractors fully equipped with power controls. This will be accompanied by the development of high-output combines for harvesting grain, potatoes, and vegetables and machines for picking cotton, the manufacture of wide-swath self-propelled reapers and new systems of efficient machinery for establishing intensive methods of crop cultivation, and setting up the production of high-quality and economical machinery and equipment for use in animal husbandry and feed production.

Major problems in the development and modernization of the metallurgical facilities of the machine-building industry need to be addressed. This, to a great extent, will determine the metal content of machines built in the future. Thousands of enterprises, shops, and departments manufacture more than 34 million tons of metallurgical blanks and stock.

There are plans to carry out the extensive modernization and to retrofit casting and forging shops with new equipment, and to close small-scale and unprofitable ones. Advanced welding techniques will be introduced: electron-beam, laser, plasma, vacuum-diffusion, explosion, and friction welding. Flexible production systems and robotic equipment will be widely used in metallurgical shops. All of these measures will help to greatly reduce metal consumption and manual labor, especially during heavy operations.

Here is but one example. Just a few years ago, the Kaluzh turbine plant made one of its turbine blades out of a 60-kilogram bar. The blade itself weighed 6.5 kilograms; in other words, almost 90 percent of the metal was machined away. The plant learned how to use precision forging. Today, the very same vane is made from a blank that weighs 10 kilograms. One-fifth as many machine tools, people, and production space is needed for machining operations. With the help of the Ye. O. Paton Institute of Electrical Welding, the personnel at the Kaluzh plant learned how to do electron-beam welding. The number of welders needed was reduced fourfold, and the quality of the work improved.

An increase in the output of new and highly productive machinery and equipment represents one side of a faster rate of technological

advancement. The other side of the process is the effective utilization of this output. During the current five-year plan, the utilization rate of plant and equipment will be increased. It is planned to bring the machine-shift coefficient up to 1.6 to 1.8 by 1990. Programmed equipment and automated lines will have this coefficient brought up to 1.9, and flexible production modules and systems up to 2 to 2.5.

Programs for accelerating the development of machine building in the 12th five year plan are backed up by considerable resources. Capital infusions that nearly equal the total amount for the previous two five-year plans have been allocated. A system has been worked out that will substantially raise the efficiency of scientific-research and experimental design organizations within the industry, sharply reduce (two to threefold) research and development time, and fundamentally strengthen the base for experimentation and testing by modernizing, constructing, and retrofitting more than 150 facilities.

Much attention is being given to the social sphere of machine building. More than eight billion rubles are allocated for the construction of nonproductive assets.

The production of consumer goods will increase 39.2 percent during the five-year plan.

High priority will be given to working together with the member countries of Comecon on an ongoing basis in the area of machine building. One of the most important features of the current stage of Comecon relations is the transition towards organizing collaboration on the basis of finding comprehensive solutions to critical industrial and inter-industrial problems ranging from scientific research and design projects for developing new technologies to organizing specialized and joint production of these technologies and establishing reciprocal trade arrangements.

"During this five-year plan, we will give a strong boost to the machine-building industry," remarked comrade M. S. Gorbachev during a speech at a convention of the active members of the Khabarovsk kray party organization. "However, in some cases, we will see the results within two to three years, and in other cases, within three to four years. As they say, we must not get ahead of ourselves. We must improve productive activity by implementing industrial organization policies that have been thought through from every angle and by using resources and opportunities that are close at hand."

During the first half of 1986, the machine-building industry as a whole developed at a surging rate. All of the ministries fulfilled their targets for volume of production output. However, major problems were also detected, since many associations have been slow to modernize. Within some ministries, the technical councils are still functioning poorly, and there is no highly-charged campaign to produce goods that can compete in international markets, to share the experience of Leningraders, who have instituted innovative compensation policies for design engineers

and started running two shifts in basic production processes.

Many enterprises and associations have not made great strides towards improving the quality of their products, nor have they converted scientific research and production functions to the economic accounting method pioneered by the M. V. Frunze Sum Scientific Production Association.

At the June (1986) plenary session of the CPSU Central Committee, it was noted that, when meeting such an important national objective as the modernization of the machine-building industry, any deviation from what has been planned can be tolerated, nor can any type of excuse, whether objective or subjective. The leadership of the machine-building ministries, associations, and enterprises, the labor collectives, and scientists and specialists must do everything they can within a short time frame to make Soviet machine building the best in the world. This was the topic of an analytical and brain-storming session of the CPSU Central Committe held at the beginning of August. Its participants assured the Party's Central Committee and the USSR Council of Ministers that those people employed by the machine-building industry would meet their assigned objectives.

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FORGE-AND-PRESS INDUSTRY GOALS IN 12TH FIVE YEAR PLAN

Moscow KUZNECHNO-SHTAMPOVOCHNOYE PROIZVODSTVO in Russian No 5, May 86 pp 5-6

[Article by A. P. Vasilyev, USSR Deputy Minister of Machine Tool Manufacturing and Tool Industry: "Forge-and-Press Machine Building in the 12th Five-Year Plan"]

[Text] The 27th Congress of the Communist Party of the Soviet Union has approved the "Basic Directions of USSR Economic and Social Development in 1986-1990 and Up To 2000."

A fundamental break-through in operation of the industry and the necessary pace and effectiveness of economic development will be ensured through the development and organization of high-quality, precise fulfillment of the new five-year plan, by mobilizing available resources and opportunities, accelerating the creative initiative of the masses, and strengthening discipline and order. All this work must be based on accelerated scientific-technical progress, retooling and renovating production, the more intensive use of the available production potential, and improving the management system and the economic mechanism.

Top priority is to be given to radical renovation and outstripping development of the machine-building complex, and foremost machine tool manufacturing, the production of computer equipment, tool making, electrical equipment and electronics industry.

Machine tool manufacturing and tool making are faced with accelerating the release of progressive equipment necessary for retooling machinebuilding -- metalworking equipment with numerical programmed control, heavy-duty and single-purpose machine tools and presses, "machining-center" machine tools, automated and robotized complexes and lines, flexible metalworking systems for sheet and die forging, for manufacturing parts using metal powder, plastics and other materials, progressive tools and machining attachments.

Equipping the country's machine building with progressive forge-and-press equipment will permit successful resolution of the task of improving the rolled-metal use coefficient, bringing blank dimensions closer to finished product dimensions, and eliminating machining operations in the manufacture of many parts.

In order to ensure the production of progressive forge-and-press equipment, we are faced with very quickly doing a great deal of work to improve the technical

standards of our own plants and associations producing forge-and-press equipment.

Primary reliance is being placed on accelerating scientific-technical progress in existing production through retooling and renovation, to which ends twice as much money is being allocated in 1986-1990 as was utilized in the 11th Five-Year Plan.

Over the 12th Five-Year Plan as a whole, the increment in forge-and-press machinery production capacity will be 2.5 times that in the 11th, with 60 percent of the increment in capacity to come through renovation and retooling.

In the first half of 1986, production associations and plants are faced with inventorying fixed production assets and evaluating the technical level of the technological processes in use and working out concrete measures to introduce modern equipment and advanced technology. We need to be bolder in ridding ourselves of obsolete equipment and replacing it with modern, automated equipment.

Many plants and associations have begun updating the active portion of their fixed assets. Thus, for example, the Barnaul Power Press Plant, the Voronezh Forge-and-Press Equipment Plant imeni M. I. Kalinin and the Odessa Automatic Press Plant are installing automated sectors for machining base parts at existing production facilities, which will allow the manufacture of high-quality parts with minimal operator staffs in the same production space.

Utilization of these sectors will permit a significant increase in the production of progressive forge-and-press machinery. The retooling plans anticipate updating the active portion of fixed assets at practically all the associations and plants of forge-and-press machine building.

Along with renovation and retooling, the 12th Five-Year Plan calls for expansion of the Khmelnitskiy Automatic Thermoplastic Machines Production Association imeni 26th CPSU Congress, the Chimkent Automatic Press Plant imeni M. I. Kalinin, the Salskiy Forge-and-Press Equipment Plant, and the Ryazan Heavy-Duty Forge-and-Press Equipment Plant.

Construction of the Ruzayevskiy Automatic Lines Plant will be speeded up. Its completion will completely solve the problem of providing forge-and-press production with heavy cast steel blanks and welded components and will create a reliable base for producing automatic lines for sheet stamping. We will begin construction of a plant specialized to produce automatic manipulators for forge-and-press machines.

Considerable capital investment is anticipated for developing and strengthening branch scientific-technical potential and expanding scientific research and design organizations, their experimental bases, and also pilot plants and experimental sectors at the enterprises.

This year, we will finish building the engineering-laboratory building of the Kuzrobot PKTI [planning and technological design institute], and an engineering-laboratory building will be built for the ENIKmash [Experimental Scientific Research Institute of Forge-and-Press Machinery] late in the five-year plan to develop the components for automated forge-and-press complexes.

The capital construction program developed anticipates radical renovation of existing production facilities, as well as the creation of additional capacity by expanding and building individual plants specialized to manufacture forge-and-press equipment.

The capital construction plans in the 12th Five-Year Plan anticipate considerable construction of housing, children's institutions, cultural facilities, and recreation facilities for workers and their families. To these ends, we also anticipate using some of the funds allocated for industrial construction. However, this will be possible only if production projects are built at lower cost than anticipated by the plan, in other words, planning institute collectives must work with the collectives of the enterprises being built to find and implement plan resolutions which will, by using the latest scientific and engineering achievements, permit putting the necessary capacities into operation at minimal cost. All of the fund for sociocultural measures and housing construction must be used to finance the construction of housing and other nonproduction projects at the enterprise.

Implementation of the outlined socioeconomic development plans of each enterprise will ensure creation of the conditions necessary to highly productive labor and personnel stability. The resolutions of the 27th CPSU Congress and the "Basic Directions of USSR Economic and Social Development in 1986-1990 and Up To 2000" anticipate outstripping development of machine building, with priority being given to machine tool manufacturing. Nearly twice as much capital is being invested in machine tool manufacturing in the 12th Five-Year Plan as was in the 11th. It is the duty of machine tool builders, by using the allocated funds economically and using modern scientific and engineering achievements, to quickly and radically renovate all the branch's leading enterprises manufacturing progressive metalworking equipment, and thus lay a solid foundation for retooling and renovating all branches of machine building.

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LITHUANIAN MACHINE BUILDING TASKS IN 12TH FYP

Vilnius KOMMUNIST in Russian No 5, May 86 pp 26-31

[Article by Lithuanian SSR Gosplan Deputy Chairman Albinas Iovarauskas: "Problems of Machine Building"]

[Excerpts] Machine building and metalworking are primary industries in the republic economy. Enterprises of these branches employ 38.5 percent of all industrial personnel, and they produce a fourth of all republic output. In a word, the achievements of all republic industry depend essentially on the results of our machine-building enterprises. In the last five-year plan, they could have been higher, had these enterprises operated at full capacity in 1985 and used all their reserves. Unfortunately, output marketing and the rates of labor productivity improvement slowed somewhat at the Elfa Electrical Equipment Plant in Vilnius and the Modulis Plant in Pabrad in 1985 as compared with 1984. The situation was no better at the Sirius Plant in Klayped and the Kapsuk Technological Equipment Experimental Pilot Plant. Analysis of the very important indicator of increased output due to improved labor productivity shows quite a lot of unused potential at the Kaunas Machine Tool Manufacturing Association imeni F. Dzerzhinskiy, the Panevezh Precision Mechanics Plant, and the Neris Production Association. At the latter two enterprises, only 87.9 and 57.1 percent of the increment in production, respectively, was obtained through higher labor productivity.

The Lithuanian Communist Party Central Committee Report to the 19th Congress points out that, "only half the automatic and mechanized flow lines have thus far been operating at full capacity, that a significant portion of the very latest equipment has been operating in only one shift" (SOVETSKAYA LITVA, 25 Jan 1986). This testifies that enterprise leaders have been paying inadequate attention to this important work sector. Only 50 percent of the mechanized lines at machine-building enterprises have reached design capacity. Nine of the 15 automatic lines employing robots are being used poorly. In 1985, only 22 percent of the mechanized flow lines at the Elfa production association were used at full capacity, only 47 percent at the arc-welding equipment plant, and only 12.5 percent at the Sigma production association. All the mechanized lines at the Kapusk automatic food machinery production association are being used at less than 50-percent capacity. This situation can no longer be tolerated. Steps must be taken immediately to ensure that all available automatic machinery and robots are properly used. Leaders, party organizations and

engineers are being held fully responsible for this important work sector. After all, the amount of high-productivity equipment will be increasing year by year, and we must learn to use it fully.

In spite of the fact that the 11th five-year plan assignment for reducing manual labor in industry was more than met, with machine-building plants freeing 4,500 workers for other jobs, certainly not all enterprises paid this the proper attention. Industry currently employs more than 120,000 workers at manual labor (along with repairmen and trouble-shooters), and 20,000 workers are still doing heavy loading-unloading and transport work. Labor collectives have been set specific assignments on reducing manual labor. These have not always been carried out satisfactorily, however. The number of workers employed at manual labor has even risen at the Elfa Electrical Equipment Plant in Vilnius and at the Zhalgiris, Komunaras, imeni 40th anniversary of October, and grinder plants.

We have thus far been unable to improve the equipment shift index. During the 11th five-year plan, it was about 1.5 percent in machine building.

Another hindrance to better use of the reserves in machine building is the insufficiently flexible economic mechanism. Much attention was paid to improving it this past five-year plan. Quite a few important party and state decrees were adopted to permit developing economic relations, regulating economic development, and using the material incentives system efficiently. A broad economic experiment occupied an important place in this work. Twelve machine-building enterprises are already operating under new economic conditions in our republic. The initial results testify that the new economic conditions have provided impetus to continued production intensification. The rates of production volume growth, output marketing and labor productivity increase have risen significantly in instrument manufacturing, machine-tool manufacturing, and at enterprises producing automation equipment. All this has been achieved without increasing the number of workers. Contract performance has been significantly improved. Product quality has improved appreciably. In 1985, the rates of production growth for output in the highest quality category were 129.3 percent higher than in 1984 in machine tool manufacturing, 114.6 percent higher in instrument manufacturing, and they comprised 45.2 and 52.3 percent, respectively, of gross output. The experience accumulated in the course of the experiment will be widely used in the future. Beginning in 1987, all enterprises of the industrial ministries will be transferred to the new methods of administration.

In order to successfully master the production of new equipment, we should first of all retool enterprises producing that equipment. However, this work is going slowly. An overwhelming majority of the fixed production assets of union-subordination enterprises operating in the republic are machinery and equipment. The updating coefficient has been insignificant and has even tended to drop year by year (it was 9.8 percent in 1980, but only 7.5 percent in 1984). The fact that many industrial enterprises have been slow to update obsolete machine-tool fleets has had a particular impact on the drop in this coefficient. Under the current normatives, fixed production assets must be updated approximately once every 20 years, and machinery and equipment once every 13 years. At the same time, during the 11th five-year plan, a total of only 1.2 to 2.0 percent of the active portion of fixed assets was eliminated annually.

There is one other complex problem: what equipment must the industrial enterprises produce?

There are several aspects to the resolution of these tasks. The first is creation of a production base to manufacture such equipment and optimum planning of the operation of that base. At present, many industrial enterprises produce for themselves the machining attachments needed for new products. However, this way is too expensive. We must resolutely eliminate bureaucratic barriers and consolidate our efforts on developing auxiliary production. Moreover, a high degree of parts and subassembly standardization would also permit available production capacities to be used considerably more effectively.

Another aspect is improvement in product quality and technical parameters. The decisive role in this area is played by the designers. In the 12th five-year plan, machine-building output will be 50 to 100 percent more productive than current models. By 1990, 85 percent of our output must be metal-machining equipment based on new technologies. Consequently, we will need to stop producing obsolescent output. We should therefore move quickly to make radical changes, the more so since 20.1 percent of current machine-building production volume is items introduced 10 or more years ago. That proportion is 25 percent at 13 republic machine-building enterprises and exceeds 50 percent at some. These figures are convincing evidence that the technical level of our machine-building output and its quality do not meet modern requirements.

What about the quality of current machine-building output? In 1985, the proportion of output in the highest quality category was 60.4 percent in electrical equipment industry, 45 percent in machine tool manufacturing, 52.3 percent in tool manufacturing, and 40.9 percent at agricultural machinery enterprises. By the end of the 12th five-year plan, these figures are to be 66, 66, 60 and 50 percent, respectively. As we see, the growth is comparatively small, 6-21 percentage points.

We can no longer continue working in the old way. A regulation went into effect the start of this year which stipulates that the prices for production-technical output not in the highest quality category will be decreased by 5-15 percent annually. Inasmuch as the amount of output marketed will not be reduced, any indebtedness will have to be covered using material incentives funds. If repeated certification fails to award a product the highest quality category, it will be withdrawn from production. This procedure is designed not only to facilitate improving product quality, but also to accelerate product updating.

While carrying out the economic intensification program outlined by the 27th CPSU Congress, we must also resolve the major tasks put forward by the five-year plan in terms of strict economy in the use of material and energy resources. Some 75-80 percent of the increased fuel, energy and raw materials requirements are to be covered through economizing. Machine builders also have considerable reserves in this area.

It is known that nearly two-thirds of all production outlays goes into raw and other materials. Reducing these outlays by just one percent would save the

state 80 million rubles. Recent work in this area has been successful. However, the needed progress is still not being seen in individual branches of industry, and material expenditures have even tended to increase in machine-building and metalworking industry.

In the course of a year, machine-building enterprises process nearly 700,000 tons of metal. Upwards of a fifth of that becomes scrap. At enterprises producing agricultural machinery, in tool manufacturing, automotive and electrical equipment industry, about 36-48 percent of the metal becomes scrap. There are several reasons. First, progressive metalworking methods are being introduced too slowly: die forging, laser machining, plasma tempering, powder metallurgy. Enterprise leaders and specialists have not been sufficiently active in this area. On the other hand, supply often leaves much to be desired, as enterprises sometimes receive metal in other shapes than required. Metal losses due to inadequate corrosion protection are high. A republic metal corrosion protection program is now being developed which will enable us to solve problems which arise in a comprehensive manner.

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METHODS TO IMPROVE OUTPUT OF MACHINE TOOLS, REDUCE COSTS DISCUSSED

Moscow MASHINOSTROITEL in Russian No 4, Apr 86 pp 2-3

[Article by I.G. Bichevskaya, engineer: "To Intensify the Production of Special Production Equipment" under the rubric :"In Favor of Accelerating Science]

[Excerpts] Securing high rates of production of special production equipment, raising its quality and reducing the specific consumption of labor and materials for the goods being produced are inseparably linked with the intensification of production, which acquires a comprehensive character in the simultaneous qualitative improvement of all the factors of production and of their use. Thus, in switching over to intensive development of production it is necessary to pay particular attention to the program-goal methods (PTsM), which conveniently unite in a single whole problems of planning and organizational-structural problems. Use of PTsM permits thorough analysis of the problem of improving planning and control over the development of production of the given equipment, consideration of accumulated experience and impartation of a systematic character to all the work. Application of PTsM gives the opportunity to determine the whole complex of factors that influence an increase in the efficiency of production, to develop a system of interconnected measures for the conservation and rational consumption of resources that will facilitate achievement of goals, and to design an optimal plan for fulfilling the established tasks and the measures that were worked out.

The realization of program measures is intended in conditions where all types of resources are limited, that is, owing primarily to intensification. In preparing the "Intensification" programs, such economic problems must be solved as increasing labor productivity and the growth of labor's technical equipment; reducing the number of workers occupied with monotonous, unskilled manual labor, especially at assembly and lifting-transport operations; technical retooling of enterprises and the replacement of obsolete and worn out equipment with high-productivity equipment; reduction of consumption norms for the production of goods and conservation of materials and fuel-energy resources; increasing capital productivity; improving labor organization and production; achievement of high final results in the work of the enterprise.

In accordance with the program it is planned to obtain the entire growth in production through growth in labor productivity, without increasing the number of production personnel; to reduce over the course of the five-year plan the

number of workers occupied with manual labor by more than 20 percent (by mechanizing lifting-transport, loading-unloading and warehouse operations and by the implementation of a mechanized warehouse comprising goods, balanced manipulators, overhead-track hoists, piler cranes and truck loaders; putting into operation machines with NC [numerical programmed control], special high-productivity production equipment; mechanization of fitting-assembly and adjustment operations).

The implementation of new, progressive technology is the chief means of increasing labor productivity. A fund-conserving form of growth for labor productivity is supplied at the enterprise, that is, an accelerated increase in labor productivity is achieved in comparison with its technological level of equipment.

By 1990 the program predicts a reduction in equipment down time and an increase in the replacement coefficient of its operation to 1.63.

It is planned to increase capital productivity and the replacement coefficient of equipment operation by technical retooling of production (implementing high-productivity equipment taking into consideration the rational utilization of its capacity instead of obsolete and worn out equipment, selling extra machines to other enterprises); combining among workers and machine operators of related professions, development of multi-machine maintenance and widening the maintenance zone; transfer to primary production of workers engaged in auxiliary operations; expanding the brigade form of labor organization and remuneration; bringing work places into conformity with the requirements of NOT [scientific organization of labor] (their making inventory and certification); systematic increase in the qualifications of workers.

Over the course of the five-year plan the program stipulates a 6.5 percent reduction in the material expenditures throughout the factory for one ruble worth of commercial production. Significant reductions are planned in the norm for consumption of material resources, including one of 26 percent in the rolled stock of ferrous metals, which is a basic construction material. This will fully satisfy the additional demand of the enterprise for rolled stock thanks to its conservation.

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THIRD ALL-UNION CONFERENCE ON ROBOTICS

Budapest PROBLEMS OF CONTROL AND INFORMATION THEORY in English Vol 15, No 2, Mar-Apr 86 pp 185-190

[Text] The Third All-Union Conference on Robotics was held in Voronezh in September, 1984. 650 specialists in robot engineering and production automation participated representing R & D institutions, design departments of the largest industrial enterprises, academic and educational institutions. Representatives of all the Ministries leading in robot engineering and flexible manufacturing took part in the Conference.

The participants carried out an in-depth and comprehensive analysis of fundamental and technical problems of complex production automation, its state-of-the-art, development trends, and advanced practical experience in running robotic systems and FMS. About 600 plenary lectures and poster displays were made at the Conference, treating major developments of robotics such as theory, design principles and implementation practice of FMS and robotic systems; social and economic problems of automation; methods of designing microprocessor-based control systems and their software supply; computer-aided design and programming; methods and means of designing robot sensors; problems of automating assembly operations; control and mechanics of robot system motion; design of actuators for robotic systems, and some more.

About half of the presentations treated, directly or indirectly, theoretical and practical problems of flexible manufacturing.

The basic system principles of the design and implementation of flexible manufacturing systems were verbalized in the paper by I. M. Makarov, Corresponding Member of the USSR Academy of Sciences. It was noted that, for the very first time, the solution to the problem of production intensification should be sought via implementation of flexible computer-aided forms of the intellectual labour which lend themselves to practically unlimited intensification rather than physical labour which has exhausted itself in terms of further intensification. The major stable trends and some important regularities obtained in the design of flexible manufacturing systems both at home and abroad were analyzed. It was noted, in particular, that the implementation of pioneer and yet imperfect FMS has already improved the mean equipment utilization factor by 30 percent, reduced the production unit cost by 10 percent, and reduced the personnel required by 30 percent. The same experience proved that the design of new highly automated manufacturing requires a substantial increase of initial expenditures and investments. Their high cost notwithstanding, the

pay-back period for such manufacturing systems does not exceed three years, on the average. A better efficiency was featured by the design projects whose implementation was preceded by an in-depth professional analysis and whose design solutions were based on complex automation of the entire process starting with the design and finishing with the manufacturing of the item.

The paper by Ye. O. Adamov and S. M. Dukarsky presented the results of a comprehensive study of the flexible automation problems and the complex nature of their solution. The structure of a pilot machinebuilding plant considered by the authors is typical for the majority of small-lot and batch series production enterprises. As it is stated in the paper, the high degree of automation, high productivity and flexibility result from a subject oriented specialization based on the use of related technological processes and standardization of parts and units employed. It is shown that irrespective of the unique nature of the items produced about 80 percent of the mechanically processed parts in terms of nomenclature and 50 percent, in terms of labor consumption lend themselves to standardization. The authors suggest a novel characteristic for the flexibility of a production system that takes account of a number of factors such as reliability, time of recovery, and equipment readiness. Practical results are reported that have been obtained in computer-aided design of industrial items, computer-aided software design for NC machine tools, and computerized production scheduling. The system presented may be treated as a forerunner of little-attended flexible restructurable computer-aided small-lot manufacturing systems.

The experience of the design and maintenance of a flexible automated production enterprise for microelectronic device assembly unique in a number of characteristics was presented in the paper by V. S. Zaburdyaev and Z. N. Slavinsky. The production system considered is based on programmed restructurable robotic assembly automata equipped with a technical vision system and speech synthesizers. The implementation of the system allowed elimination of the operator from the monotonic hard production process resulting in a sharp decrease of the rejection, improvement of the product quality and productivity of the assembly lines. Further efforts are focused around the increase of the degree of automation and intelligence of the assembly control system with the use of the intelligent computer graphics systems and speech synthesizers. The Conference has noted that the system presented by the authors exceeds similar foreign designs in a number of indicators.

The design concept and the experience of the step-by-step implementation and maintenance of a flexible manufacturing system was reported by L. B. Lobikov, A. I. Savina and A. S. Uksusov. The authors' efforts went along the following three directions: design of computer-aided systems, technological detailing and on-line executive control of the production. The authors note that the greatest pay-off may be obtained from a large-scale automatization of the entire production process, therefore the first stage in the design and implementation of the system implied the design of a flexible computer-aided mechanical processing system. The concept used by the authors dictated the need to design a family of industrial robots for which some new design and algorithmic solutions were developed in order to provide an increased rated load capacity and precision of positioning of the robots.

The design of FMS control system software and its components was the subject of the paper by P. N. Belyanin and G. N. Rapoport. The greatest difficulties in designing flexible manufacturing systems, in the authors' opinion, are associated with software design. This part of the project takes up 30 to 50 percent of the labor consumed by the entire FMS design. The paper suggests a classification of control plants, control systems, and computer means used in realization of control. The results obtained by the authors allowed a software structure to be proposed invariant to control systems designed for plants of different classes. This unified approach permits a computer-aided system to be developed for designing FMS software and its components saving time and labor consumed in software design by a factor of 15 to 20.

Besides the above papers devoted to large-scale complex designs about 40 papers submitted to the Conference treated various application and theoretical problems inherent to FMS design.

An evident trend in FMS design is a stepwise approach from robot-assisted technological complexes to highly automated shops and production bays. This approach requires efficient pre-design analysis and draft design techniques resting upon the use of fundamental principles of system analysis and critical generalization of the experience obtained in designing similar systems both in this country and abroad.

A number of papers were devoted to problems of on-line planning and control in flexible manufacturing systems. As a rule, FMS are equipped with expensive highly productive facilities whose efficiency is largely determined by the quality and performance of production plans and facility load schedule. Two major trends may be isolated in this area of research. The first deals with designing models and algorithms of optimal equipment load scheduling which take account of the specifics of the concrete type of production. The second is focused on the design of interactive dialogue procedures forcreate and update production schedules. A number of papers were devoted to the design of application software programs for flexible manufacturing systems scheduling.

The basic principles of training the FMS specialists were considered in the paper by Yu. M. Solomentsev. The author noted that the technological progress in the home machinebuilding industry should rest upon wide implementation of modern technologies employing robotic systems, microprocessors, computer-aided design and control systems. To fulfil these new tasks researchers and engineers should be trained specializing in the design, implementation and maintenance of flexible manufacturing systems. The training of specialists may be successfully carried out with the help of the program-oriented method based on such principles as the complex and purposeful approach, flexibility of personnel training, etc.

Industrial robots in national economy

The papers treating the above subject considered theoretical and practical problems pertaining to the design and application of robotic complexes, stand-alone robots and their elements. The papers show a substantial experience obtained in the last few years in efficient application of robots to all national industries. Active robotization is taking place in such non-machinebuilding industries as construction, agriculture, mining, lumbering, textile, food industries, etc. The use of robots in these industries is considered in about one third of the papers treating this subject.

Original design of manipulating robots and their parts were presented, in particular, the UEM-5 robot and electromagnetic-control led microrobots. Some papers suggested new design and analysis methodologies pertaining to the design of grippers and geometric parameters of manipulator members, analysis of kinematic structures etc.

Methods and tools for robot sensor design

The state-of-the-art and problems of designing adaptive robots incorporating sensory systems were presented in the paper by Ye. P. Popov, Corresponding Member of the USSR Academy of Sciences. The author noted that a wide spectrum of sensors is available today (torque and tactual sensors, displacement transducers, small-distance measurement gauges, etc.). The basic task at present is the design of algorithmic and software supply for microprocessor-controlled robot sensory systems for various industrial applications. The paper discusses the basic principles of hardware structurization and software design for such systems. The experience and results are presented obtained in semi-pilot simulation of industrial robotic systems with developed sensory systems. Problems pertaining to the design of software for such systems are considered.

The experience of the adaptive robot torque sensory systems design was generalized in the paper by V. S. Gurfinkel and Ye. A. Devyanin. A number of technical problems were given for an appropriate solution such as the approaching of a robot to contact a part, the gripping of a part, the joining of elements, the handling of parts stored in bulk, and some more. The authors reported on the design of a number of torque sensors including modular sensors, systems of sensor signal processing and conversion and robot control algorithm. The robot torque sensory systems were proved most useful for the purpose of learning.

The analysis of papers presented at this Section shows that the major research and application areas are the design of efficient vision systems, torque sensors, displacement and small distance transducers and tactual sensors.

Assembly operations automation

Automatic multioperation assembly systems employing industrial robots were discussed in the plenary paper authored by D. Ye. Okhotsimsky, Corresponding Member of the USSR Academy of Sciences and S. S. Kamynin. The authors carried out a comprehensive analysis of the assembly operations specific features which helped them verbalize a number of principles realizing such assembly operations as the insertion of a shaft into a hole with a snug transition fit, the setting on and screwing up of a nut, and some more. The paper reported on a high level language developed for the programming of assembly operations and the basic principles, in particular, the maximal closeness to the user vocabulary of terms and wide use of learning procedures. An ad-hoc visual system controls the correctness of the assembly process. The control rests upon the comparison against standard scene images. The experiments carried out by the authors at the laboratory model of the assembly robot proved the principles to be simple and effective in fulfilling a wide set of assembly tasks.

A number of papers discussed the results obtained in the design of computer-aided systems for the analysis and design of assembly centers and lines. Simulation is the tool increasingly employed in designing such systems. Much attention was given to the increase of flexibility of assembly processes in order to make the production less sensitive to diversity of the nomenclature and nonuniformity of flows of the parts to be assembled.

Mechanics and processes of control

A large group of papers presented at this Section dealt with the problems of increasing dynamic accuracy and optimal control of industrial robots. The statements and solutions of such problems should rest upon a more comprehensive recognition of actual properties of robotic systems such as elasticity of manipulator members, pliability of kinematic drives, limited drive power, etc. Problems pertaining to the motion control of adaptive robots equipped with complex sensory systems were also considered. A substantial progress was noted in the design of the motion control systems with torque sensors.

Transport robots

The Section treated the problems of designing the three major types of robots: FMS transport robots, transport robots capable of moving over rugged areas, and underwater robots.

In designing FMS transport robots, the modular principle of designing a robot and its environment was further developed which allows fast extension and rearrangement of the FMS. The major attention was paid to the design of the transport robot elements base and the corresponding software.

Self-contained transport robots capable of moving over rugged areas were most widely presented. The problems considered included those of designing motion control systems and route selection. Analog and digital robot motion control systems were discussed. Major attention for the digital systems was paid to the use of microcomputers and microprocessors. Methods of supervisory transport robot control were considered.

An essential number of papers treated mathematical modelling of locomotion robot dynamics. Six-leg, four-leg and two-leg robots were considered. A promising approach in increasing the speed of locomotion robots is in refusal from the principle of static stability and applying dynamic forms of motion.

A number of papers were devoted to problems of artificial limb design The papers gave evidence to the fact that one of the promising trends is the design of electrically driven lower extremities prostheses.

Computer-aided design

The Section considered a wide spectrum of problems from the computer-aided design of FMS structures and arrangements to modelling specific production plants.

A number of papers gave consideration to the problem of choosing and allocating the facilities within the FMS plant. A methodology of allocating the equipment is suggested which minimizes the transportation expenses. A man-machine stochastic procedure is designed for the multicriterial equipment selection. A substantial part of the papers submitted to this Section tackled simulation of FMS subsystems, one of the most powerful tools in studying the systems. A set of models were suggested to investigate FMS in radioelectronics. A CAD system for curvilinear surface milling processes and a mathematical model of a robot-operated die forging complex were considered.

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ROBOTICS

EXHIBITION ON 'INDUSTRIAL ROBOTS, THEIR COMPONENTS'

Budapest PROBLEMS OF CONTROL AND INFORMATION THEORY in English Vol 15, No 2, Mar-Apr 86 p 191

[Article by V.M. Nazazetov]

[Text]

An exhibition was organized on the "Industrial Robots and Their Components" in the same time when the Third All-Union Conference on Robotics was held. More than 30 organizations from 17 cities and six Soviet Republics displayed their designs. The exhibition presented more than 90 exhibits including 50 operating full-scale displays. Some exhibits were made in the form of models, brassboard operating models or panels displaying robotic complexes, flexible manufacturing systems and their components such as computerized transportation and warehouse systems, automated modules of mechanical processing, die forging, etc. A large section of the exhibition showed robot sensors and pick-ups of diverse purposes — visual, locational, tactile, heading etc. Samples of industrial robots of various designs and orientation were presented, such as balanced, pneumatic, electromechanical etc. Drivers and actuators, control and diagnosing devices, control units and their elements were displayed as well.

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USE OF NC TOOLS, ROBOTICS IN MAINTENANCE SERVICE ANALYZED

Kiev EKONOMIKA SOVETSKOY UKRAINY in Russian 9 Sep 86 pp 54-58

[Article by B. Kondratyev, director of the Khartsyzsk Pipe Factory, N. Malyavin, shop manager, and T. Ratushenko, candidate of economic sciences (Donetsk): "Application of NC Machine Tools and Robot Complexes in Maintenance Production"]

[Text] At the present time resolution of the basic economic questions involved in the development of the national economy depends to a great extent on a rapid increase in the efficiency of overall production. Raising the technological standard of the ferrous metallurgy maintenance capability and fundamentally renewing its basic assets through the introduction of mechanization and automation in manufacturing are of great importance in this task.

The current organizational level of maintenance service in ferrous metallurgy does not satisfy requirements for production efficiency. Each year expenditures for all types of repair exceed capital investment levels in the sector. Only 30-40% of the sector's need for spare parts is being satisfied. As a result a significant portion of setup work is performed during repair periods. This complicates the repair process, reduces repair quality and forces the enterprise to produce an increasing number of spare parts on its own.

This situation also applies to all subsectors of the ferrous metallurgy industry. Growth in the volume of enterprise basic production assets, an increase in individual machine capacity, intensification of production processes and the presence of obsolete equipment are causing a continuous increase in labor expenditures for maintenance and repair. In 1983 the Ukrainian industry's ratio of repair expenditures per ruble of commercial pipe production rose by 15% in comparison to 1980.

The enterprises' repair base is primarily equipped with general-purpose equipment and is organizationally and technologically far behind developments in (basic) metallurgical production. Therefore, it is not satisfying the demand for increased efficiency. Almost any product can be manufactured on general-purpose manually controlled machine tools, but servicing these machines requires a greater number of highly trained workers and machine

operators whose productivity is lower than that of workers servicing automated machinery in mass production by an order of magnitude. When labor resources are limited this leads to incomplete utilization of the enterprise machine base. Thus, the mean shift utilization coefficient for metal-cutting machinery at seven Ukrtrubostal Republic Production Association factories was 1.26 in 1983. The Ukraine's pipe factory repair units are not fully staffed with machine tool operators; the shortage at individual enterprises ranges from 3% to 20%. The problem has worsened since that time. Additionally, the components produced in ferrous metallurgy enterprise repair shops are significantly less reliable than similar parts produced at machine building industry factories.

Questions of supplementing the repair base are critical for those enterprises which have recently undergone qualitative changes due to reconstruction, production equipment refitting and the introduction of more productive machinery and progressive manufacturing processes. Research conducted at the Khartsyzsk Pipe Factory has shown that the fundamental reconstruction of basic production carried out here has resulted in a sharp increase in the capital-labor ratio but has not produced the required productivity increase. This situation is to a great extent caused by the fact that the factory's development has not been accompanied by an adequate increase in the repair base's technological standard.

The repair base of any ferrous metallurgy enterprise engages in small-scale and even one-off production of a high number of products. Here (in contrast to the machine building industry's stable product line), production setup expenditures for a frequently changing output requirement and an unstable distribution of orders during the year have a pronounced effect on machine tool equipment productivity.

At the current stage of economic development the primary trend in increasing maintenance production efficiency must be renovation of its equipment based on the acceleration of scientific and technological progress. This primarily involves a conversion from conventional metal-cutting equipment to highly productive numerical control (NC) machine tools equipped with industrial robots. This approach permits the release of workers occupied in especially difficult and unappealing manual labor and at the same time guarantees high final product quality. It also is a step toward decreased human participation in production processes and makes the machine tool operator's profession a more attractive and prestigious position.

Analysis of NC machine tools and robotized complexes (RTKs) has shown that this innovative equipment is still not very efficient. Comparative data on times to produce identical components show that NC machine tool and RTK productivity is only 1.7 times higher than that of general-purpose metal-cutting machine tools. The growth in product output on new machines is significantly below their potential. The utilization time rating for NC machine tools and RTKs at the Khartsyzsk Pipe Factory was 60% in 1983. This indicator is definitely better than the 20-30% utilization factor at other subsector enterprises with similar equipment. This, however, is an indication of inadequate utilization of new metal-cutting equipment and a low level of production and labor organization.

The decisive factor in manufacturing development is that equipment cannot in itself accelerate the growth in labor productivity. Production efficiency depends not only on the level of equipment and manufacturing process modernization but also on the enterprise's organizational structure. Retention of outdated and traditional forms of labor organization in maintenance production is delaying increased efficiency in the utilization of potential capacity to improve new equipment productivity through a successive reduction of lead times for the procedures and methods involved in its operation.

An analysis of enterprise (shop) operations in small-scale production of a large product line shows that a blank is actually located at a machine tool during only 5% of the entire manufacturing cycle. One-third of this time is devoted to the shaping process. The rest of the time is taken up by setup, auxiliary and finishing operations: up to 35% of the time is spent waiting for blanks to come from the warehouse and movements within the shop, while up to 27% of the time is expended setting up the blanks and then resetting the equipment.*

Reduction of the time spent waiting for blanks is a tremendous means of reducing production process times and reducing the volume of intermediate stockpiles and intermediate products. It is one of the central technical and economic tasks arising in the organization of flexible automated manufacturing facilities. These tasks can be resolved by using automated systems for controlling maintenance item production which above all include automation of pre-production engineering, the component machining process and transport/storage operations.

The inadequate level of NC machine tool and RTK efficiency in maintenance item production is explained to a great extent by the fact that this equipment is used to produce a large line of components. One of the fundamental trends in improving the use of new metal-cutting machine tools is one of equipment capability expansion and specialization in the production of a small number of standard components combined with further restriction of this output to small shops at similar enterprises located close to one another. The absence of specialization in automated equipment is causing significant losses of time on machine tool resetting and control program preparation and debugging. The time for these operations in each individual case is 4-5 hours for RTKs and up to 1 hour on NC machine tools. It must be said that at the Khartsyzsk Pipe Factory equipment downtime for tooling and control program development is comparatively low and does not exceed 8% of nominal operating time. Here the control program creation and debugging labor reduction and the machine tool utilization coefficient improvement were achieved through the introduction of a computerized control complex. The complex is centered around the automated production engineer workstation (ARM-M) which permits the coding of component data directly from a drawing, addition of any necessary corrections, duplication on a plotter and the creation of drawing libraries. After graphic and textual information on the component has been entered in the computer, a control program can be created and then tested for accuracy on the plotter.

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* Goryshkin, V.I. "Sostoyaniye i perspektivy razvitiya gibkoy avtomatizirovannoy tekhnologii v promyshlennosti", [Status and Future of

Flexible Automated Technology Development in Industry], Minsk, 1983, p 44. The high-quality programs produced in this manner assure minimal time loss during running and debugging. Nearly 1500 control programs have been developed since the automated NC machine tool section integrated with the ARM-M system based on the SM-1407 computer has been in operation at the factory.

This computer complex integrated with the automated production engineer workstation operates on the basis of a grouped production process which logically separates components according to the design and process similarity of their manufacture and to the shape and dimensions of the blanks used. Widespread introduction of grouped methods for organizing production into sections equipped with NC machine tools and RTK allows the standardization of component manufacturing processes. This is due to the fact that when producing a given group of components only a change of perforated tapes is needed to shift from machining one component to another and tool changes or machine retooling are eliminated. The reduction of these time losses will enable more efficient automated machine tool utilization and make even small-lot component production more economically profitable. For example, component lot sizes vary widely at the Khartsyzsk Pipe Factory, primarily in a wide range from 10 to 100, but the recent introduction of the grouped method has enabled an increasing shift toward smaller numbers.

Finishing machine tools (gear, worm and thread grinders; worm and slot cutters; broaching machines; etc.) are economically unsuitable for final component processing in one-off and small-scale production because the complicated level of production organization combined with the comparatively low machine tool capacity in maintenance subunits will not allow equipment load levels over 10%. When large quantities of parts are produced at central facilities using NC machine tools and RTKs there is a significant increase in the utilization of highly productive machine tools and automata intended for final component machining. Their use in the production stream will enable a definite improvement in component quality and a marked increase in component operational reliability.

At the present time the greatest significance must be placed on a quick resolution of the question of component hardening by chemical and thermal methods. This would cause a 3 to 4-fold increase in component costs while bringing about an equal reduction in component demand. The conclusion is confirmed by data concerning a change in the resistance of a hydraulic cylinder plunger operating in a corrosive environment. Its service life was extended from two weeks to six months (12-fold) when a wire powder was fused to the plunger.

Automated metal-cutting equipment cannot be used with high efficiency without the existence of a set of measures to improve pre-production engineering. The increased final product technology level demands in effect at this time are providing maintenance services with more progressive types of blanks by means of stamping because the use of traditional forged stock (forgings) results in a high level of metal wastage through chipping. Thus, in 1983 more than 1/4 of total blank weight was lost to wastage in the Khartsyzsk Pipe Factory's machinery and repair shop. This level was even worse for some items. For example, the weights of blanks used in machining the P-1789 shaft and 4KB-

14446-17 gear were 12.3 and 2.6 kg respectively, while final product weights were 6.6 and 1.3 kg, or about 50% of the gross weight. Moreover, excess metal removal causes additional labor time expenditures on the new equipment. This leads to more than a 2-fold reduction in its product output capability.

Implementation of measures to provide the ferrous metallurgy industry's repair subunits with progressive types of blanks is of great importance in improving the efficiency of any metal-cutting equipment, including general-purpose machine tools. However, in the case of NC machine tool and RTK operations where the "true cost" of losses is significantly higher, the shift to stamped blanks is especially critical.

An inevitable result of the rapid introduction, effective operation and expanded scope of NC machine tool application in maintenance management is the creation at one of the enterprises with experience in operating this type of equipment of a center for training and improving the qualifications of the workers, engineers and programmers who operate and maintain the new metal-cutting equipment. Inadequate knowledge about the modern equipment leads to frequent breakdowns and loss of time on repair, which currently amounts to at least 20% of nominal operating time. The Khartsyzsk Pipe Factory can serve as one of these centers. Here component machining on NC machine tools and RTKs has been widely distributed among subunits and has necessitated the training of personnel capable of servicing this equipment. At this time 12% of the shop's equipment base is made up of automated metal-cutting machinery. These machines produce more than 19% of the total component output and manufacture more than 600 types of components. This proves that the new section's flexibility is fully satisfying today's demands for maintenance item production in its first stage of operation.

For a fundamental increase in spare part production efficiency the machinery and repair shop will have to become fully self-supporting. In practical terms this could be done at the Khartsyzsk Pipe Factory where a number of parts are already being produced for various enterprises in the republic's ferrous metallurgy industry. In 1984 alone, it produced more than 15 thousand sleeve halves, axles and shafts for the Makeyevka Metal-Cutting Facility imeni S.M. Kirov, 6000 rollers for the Makeyevka Pipe Forging Plant and nearly 1000 "shaft" products for the Khartsyzsk Steel Cable Factory.

Improvement of the cost accounting system first of all requires increased relevance on the part of the system of indicators used to plan and evaluate the machinery and repair shop's activity, mechanization of production planning and computer-based evaluation and analysis of machine tool utilization. Special attention must be devoted to improving the salaries of workers servicing the new equipment, to material incentives for expanding the extent of multiple machine tool servicing, to further increasing the efficiency of a team approach to labor organization and to stimulating team collective interest in the shop's bottom line. To these ends the factory has already developed an automated system for controlling pre-production engineering based on the grouped method of component production and has created an on-line calendar planning system which will optimize the new metal-cutting equipment tasking schedule and solve problems encountered in improving other subsystems

for controlling, estimating and analyzing the machinery and repair shop's activity.

A proper cost accounting organization first of all requires an effective system of technical and economic indicators for planning and evaluating the results of work by the shop and its subunits. The component production volume must be the key link in the indicator system. It must take into consideration the variety of products manufactured and the various types of machines on which products of identical dimensions and grades of steel can be produced. Under these conditions, it would not be economically suitable to use different standard indicators dependent on specific equipment productivity to plan the production volume of the same products in the shop. This would lead (as is the case now) to the violation of one of the most important principles of pricing which forms the reason for an identical price for the same type of product. To prevent this the machinery and repair shop's product output planning must be based on stable labor indicators which should only vary according to component brand, grade and quality considerations. A fixed, flat machine tool hour, calculated on the basis of average-progressive machine tool utilization parameters, could serve as the basis for such an indicator. Use of this indicator would allow the evaluation of shop production plan and labor productivity fulfillment and would provide a true picture of the dynamics of these factors. Moreover, this would create additional incentives for improving labor productivity since the use of fixed performance indicators will facilitate the distribution of components to machine tools which can produce them more economically. For cost accounting purposes, the product cost reduction and standard salary output indicators are combined in a fixed standard machine tool hour value.

The material incentive system's efficiency determines the effectiveness of shop cost accounting. To increase the machinery and repair shop collective's interest in and responsibility for increasing labor productivity and economizing in the use of all types of resources, rewards to workers, engineering personnel and clerical personnel should be made directly dependent on the final results achieved by the shop's efforts. To this end it is appropriate to set up a shop incentive fund (within the framework of the factory-wide material reward fund) established according to the principles applied to the entire factory.

Indicators such as the pace of product output increase in conjunction with planned order fulfillment, labor productivity, product cost reduction and product quality improvement can be the basis for the fund. Calculating the shop material reward fund on the basis of the first three of these indicators would pose no difficulties. The matter of product quality will require the consideration of standard service lives on customer equipment and the development of a system to evaluate the achievement of these values. The standard service life is the minimum period which satisfies the demands of high-quality products. In this connection, supernormal service lives are established by product group and in-house quality awards are issued to the components which satisfy those conditions. The development of standard allocations to the shop incentive fund for such products is planned as a means of increasing worker interest in improving product quality. In turn the fund must be reduced according to similar provisions when one or another group of

components does not meet the standard service life requirement. Shop workers are similarly rewarded for meeting component order fulfillment periods. In addition to this a system for materially rewarding savings in metal utilization must be developed. Here it is important that the reward be not less than 50% of the savings obtained.

Shifting the machinery and repair shop to a fully self-supporting status creates the grounds for economical and more logical use of all manufacturing resources and a change to waste-free production processes. Thus, the chips created in the shop can be pelleted or processed in a plasma spray unit to obtain metal powders for subsequent shipment to metallurgical factories or to powder metallurgy enterprises.

Every year some 15-20 thousand high-speed steel cutter bits are exhausted in the production of components on edge-planing machine tools. Remelting the cutter bit heads in an electroslag melting unit can provide 4-5 tons of high-quality steel in the shop each year. This steel could be used in the factory or, after conversion to powdered form, could be shipped to machine building industry enterprises to build devices using powder metallurgy techniques. Processing of the by-products mentioned here will permit a corresponding reduction in production component cost and, additionally, the designation of 70% of this amount for the machinery and repair shop's material incentive fund.

The re-equipping of the enterprise maintenance base must not be seen as an end in itself. Experience gathered in working with NC machine tools and RTKs at the Zaporozhstal and Krivorozhstal metallurgical facilities, as well as at the Nikopol Southern and Khartsyzsk pipe factories has demonstrated that the change in maintenance item production equipment taking place as a result of scientific and technological progress is replacing manual labor with machines, and is automating not only machining operations but also the control of all component production processes. This is creating objective requirements for improving the conditions under which maintenance item production takes place and the quality of its personnel, lowering the shortage of personnel, improving the work station/labor resource balance and increasing the efficiency with which they are used. This is one side of the question. The other side is that the use of NC machine tools fitted with robots provides the possibility of markedly improving the enterprise bottom line as well as that of the entire sector. This improvement can be obtained on the following basis: lowering basic production equipment downtime for repair through improved spare part availability; lowering labor expenses for repair; correspondingly increasing production output; and reducing the number of maintenance personnel in the basic shops by increasing the time between equipment repairs.

Therefore, the establishment of automated sections (shops) equipped with computer-controlled NC machine tools and RTKs requires the solution of a number of problems involving the improvement of organizational, hardware and software support of maintenance item production which in turn requires rather high capital investments (especially during the initial stage of introduction) and the services of highly trained specialists. These problems cannot be solved and these situations cannot be created by the efforts of one enterprise alone. No enterprise can autonomously, and without ministry support, bring

about a sharp increase in maintenance item production efficiency because solving this problem requires the expenditure of financial resources and assets on new equipment.

Further improvement in the UkSSR Ministry of Ferrous Metallurgy's maintenance capability is possible by establishing several regional machining centers (sections or shops), equipped with highly productive automated lines and robotized complexes and specializing in the production of standardized components (rotary components, housings, etc.). These all-new machinery and repair centers should be developed in an integrated manner and equipped with automated computer complexes, finishing machine tools and equipment to produce stamped blanks in conjunction with the use of modern, resource-sparing technologies for the production of spare parts.

Thanks to high productivity and flexibility, each of these complexes will be able to supply its products to not only one, but a group of ferrous metallurgy enterprises. On the basis of the experienced garnered it seems suitable to organize specialized production of rotary type spare parts at the Khartsyzsk Pipe Factory. All the conditions are right here: a material and supply base for maintenance item production has been established, experience has been gained in the use of highly productive NC machine tools and RTKs, equipment failure reasons and frequencies have been studied and equipment reliability has been analyzed. The enterprise has the ability to further develop its maintenance base by allocating a 2000-square meter portion of the new integrated automation section to the machinery and repair shop. This means that spare parts production over the next 2-3 years can be concentrated in a single section.

The Kommunarsk, Makeyevka imeni Kirov and Dneprovskiy imeni Dzerzhinskii metallurgical facilities can serve as the sector's basis for machining complex housings on NC and "machining center" machine tools. New automated equipment at the Nikopol Southern Pipe Factory is already specializing in the production of pipe tools. In a future expansion of its machinery and repair shop the enterprise will be able to supply its products on a cooperative basis to all of the Ukraine's pipe industry enterprises.

Estimates show that the economic effect of the introduction of a regional technical center for component machining in the Ukrtrubostal Republic Production Association is at least 500-550 thousand rubles. The estimated capital outlays involved in creating this center do not exceed 1.2-1.3 million rubles.

The creation of regional flexible manufacturing facilities for machining in the sector will allow the elimination of conflicting shipments of blanks and final products, a reduction in shipping costs and the creation of conditions better suited to supplying spare parts to consumer-factories in a timely manner.

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FMS, AUTOMATION BENEFITS IN PRESSING, MACHINING FACILITIES DISCUSSED

Moscow MASHINOSTROITEL in Russian No 4, Apr 86 pp 10, 11

[Excerpts from article by V. L. Lishayev and V. P. Duranin, engineers: "Flexible Manufacturing Systems Equipment in Sheet Metal Stamping"]

[Excerpts] In the manufacture of parts out of rolled sheet metal stock, increasing the GPS's [Flexible Manufacturing System] flexibility factor--one of its primary indicators--is achieved by using numerical controlled [NC] equipment; by increasing the number of operations carried out on a single machine; by setting up sheet-forming complexes using NC equipment and robotics complexes using crank presses; by automating the die change on the presses, the material cutting and the die designing.

An examination of the production equipment being manufactured in the industrialized nations shows that at present there is an extensive product-mix of forging and pressing equipment with NC being produced for working sheet goods: guillotine shears, rotating beam press brakes, blanking turret presses, sheet bending machines, roller shears, spinning lathes etc. NC systems are used on this equipment either to control the manufacturing process via the machine's kinematics (machines such as nibbling shears, sheet-metal bending presses, rotating beam bending presses and guillotine shears), or through the use of a tool (revolving presses).

Equipment which carries out a number of different manufacturing operations, which reduces handling time and reduces transport and storage costs has great potential for increasing production flexibility. A good example of such equipment would be the turret presses which have been used widely and are designed for the manufacture of parts of a type of panel having openings of varying shapes and sizes.

It is now possible for large-scale production runs to be automated thanks to the introduction of progressive dies or multiposition presses with built-in transporters, and these units cost less than robots. At the same time, industrial robots are fine where the parts list is extensive and the run is small, and when the transport devices are not competitive because of their low degree of flexibility. In addition, robots are used in those cases where a small number of workers can service several presses, as well as in cases of single operation machining, as in the case of single-operation dies, where the parts

are quite large and cannot be manufactured on a multiposition press, and where a single operation die is used which increases the metal utilization factor.

In connection with the fact that all-purpose robots are unsuitable for use with sheet bending presses (due to the complexity of the blank's moves during the bending operation), special robots have been devised for this equipment. It might be well to point out that these robots work in conjunction with guillotine shears to feed and position the sheetmetal on the shear table. Where a robot is used the hourly labor productivity can be less than it was before the robot came into use. However the shift productivity will be higher.

It is impossible to set up flexible production systems where die replacement has not been automated. This is explained by the fact that at present it takes from 0.5 to 1 hour to replace average sized dies, with four hours needed to replace large dies. The problem of mechanizing and automating die replacement has been solved by changing the design of the press table, by developing hydraulic and pneumatic clamping devices and by using microprocessor-controlled NC.

The device used for quick tool replacement on hydraulic presses allows the die to be replaced in two minutes, and includes a hydraulic die fastening system, a freely programmed system from a microprocessor, a die rack, and automatic lifting onto the cart.

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TECHNOLOGY PLANNING AND MANAGEMENT AUTOMATION

SHORT-TERM, LONG-TERM TECHNOLOGY TASKS, GOALS DISCUSSED

Moscow NTR: PROBLEMY I RESHENIYA in Russian No 10, May-Jun 86 pp 4-5

[Article by Candidate of Economic Sciences M. Karpunin and Candidate of Technical Sciences R. Vcherashniy under the rubric "The Problem of Major Planning": "Information on Machinery That Does Not Yet Exist--Draft Plan of an Information System on Future Equipment"]

[Text] At the center of this concept is scientific and technical information. But we will begin, perhaps, with a warning. A designer, oriented toward an analogue, including a foreign one that corresponds to the highest world achievements, already dooms his future machine to backwardness. In order to overcome this, which has become extremely fashionable recently, no other orientation point is needed besides sensible thought. In fact, over the time taken up by NIOKR [scientific research and experimental design work], the incorporation and circulation of "new designs" cut according to the fashionable style mentioned, it itself, as the design oriented toward it, squanders its novelty and attractiveness. This means that the most trustworthy and complete collection of the best examples of existing equipment, while reliably orienting commercial practice (moreover, in far from every case), is in no case a strategy for scientific and technical progress. This position is taken into account to a certain extent in the recent decree of the GKNT [State Committee for Science and Technology] and the USSR Academy of Sciences on the creation of a problem-oriented database within the framework of the GSNTI [State System for Scientific and Technical Information]. It is now a matter of practical steps in this direction, and beforehand--the development of individual conceptual structures that facilitate the formation of depictions of future equipment.

Three Views of the Future

A few words about the perspectives to which the foresight of the designer should extend who is capable of advancing not in pursuit of already-realized scientific and technical achievements, but in pursuit of those so that on the verge of entry into the mass exploitation, the design in and of itself would be of such a high level that it is impossible to copy, and the designer himself is required to predetermine through his own creativity.

Three such perspectives are clearly discernible in socialist planned economics.

The first is the view to a year ahead, the yearly plan. Within this framework, the management specialists are concerned with designs already developed which are awaiting incorporation or series production. A knowledge of the best domestic and foreign models permits just the resolution of issues of modernization and the reduction or expansion of the production of this or that model of equipment.

The second perspective is the five-year plan. New equipment, the production and assimilation of which is planned for this period, as a rule, already exists in the form of technical designs, but they are still awaiting incarnation in technical documentation and then in metal. The optimal correlation of machinery systems and complexes must be chosen here, the economic expediency of their manufacture of the new equipment must be determined and the entire circle of consumers--obvious and potential--must be discovered.

The third time perspective is the 10-15-year perspective. Over this time, new generations of equipment are created based on new and revolutionary technology. They are formulated as a means of achieving certain social and economic aims for the long term.

The next such period of scientific and technical progress in the sphere of machine building was clearly stated in the resolutions of the 27th CPSU Congress: "Machine building is called upon to produce machinery systems and complexes along with equipment and instruments of the highest technical and economic level that ensure revolutionary changes in the technology and organization of production, a many-fold increase in labor productivity, a reduction in materials and power consumption, an improvement of product quality and a growth in return on investment."

In order to create "informational prototypes" of equipment and technology that revolutionize social production, a new informational strategy is essential.

Machinery, Systems, Complexes

In order to continue our discussion it is essential to give at least an early draft definition of several concepts.

In the incorporation of new methods of functional planning (and cost-function analysis in particular), a situation is often encountered when it is necessary to make a choice among some aggregate of functionally identical devices. Thus, the work of a drive can be executed by electric motor, internal-combustion engine, turbine, pneumatic or hydraulic motor, reaction engine etc. By the way, the circle of basic functions here (heating, the transfer of torque, signaling, materials machining etc.) is quite limited.

At the same time, there is still no universal concept uniting the tools of labor of one functional designation. The appropriate planning is also not practiced. Technical equipment is produced basically in series that take shape within the bounds of the appropriate producer sectors. Therefore, by way of example, the capacity features and other features of drives based on various principles that have taken shape in various sectors may also not coincide.

We define the aggregate of technical equipment of one functional designation employed as basic or built-in assemblies or units as a machinery system.

A machinery complex is seen as the aggregate of technical equipment oriented toward this or that other technology and, especially, for obtaining specific types of products, materials, power etc.

The optimal combination of the functional and product principles in the creation of prospective technical systems depends precisely on the socialist system of production and its planning regulation directed toward the satisfaction of social needs. This opens up the possibility of a transition from the formation of planning conceptions of the individual projects of the new equipment to the qualitatively different systemic planning of interconnected machinery systems and complexes and their practical realization in the technical projects of new generations. The most progressive and economically efficient solutions that permit not the improvement of uncoordinated machines taken individually, but the renewal of interconnected systems and complexes, can be achieved.

The level of each component in such a system or complex should be determined taking into account the basic theses of systems technology. By way of example, the aggregate of the best machinery making up a complex as its elements still does not determine the optimal state of the entire complex of machinery oriented toward a certain technology...

We note that the selection of standards for evaluating the level of prospective technology with the appropriate modern conception is quite a complex task. It is still not corroborated by methodological recommendations. Its resolution is essential for adjusting the interaction of the lead enterprises and organizations of various departmental affiliations. In other words--for the practical conduct in practice of a unified state policy in the sphere of developing the machine-building complex of the country.

It must be said that we could be better prepared for all of this if we were occupied with the consistent and systematic evaluation of the level of individual machines.

As early as 1981 GKNT, Gosstandart [State Committee on Standards], Gosplan and Gossnab adopted a decree on the introduction of systematic evaluation of the technical level of the quality of machinery, equipment and other technology for the certification of these products according to category of quality. In addition to the traditional evaluation of finished products, an evaluation of the level of technical requirements, the technical documentation that was developed and the experimental prototypes of the equipment that are created was introduced.

Over the five years that have passed, however, the necessary efforts for the incorporation of such a procedure were not made--an appropriate informational base for evaluating the technical level has not been put together.

Informational Prototypes

New results in basic research traverse a long path of 7-8 years before they are embodied in actual machinery and instruments. This means that the shape of new generations of equipment is being born in the laboratories of the academic institutes. This new knowledge must be brought in a new way to those who determine the distant future, especially through the State System for Scientific and Technical Information [GSNTI].

The necessity therefore arises for new forms of interaction of the information services of the USSR Academy of Sciences, the higher-educational institutions of the country and the sectorial informational centers. This triad should create the machine-oriented informational models of future machinery and its complexes and systems built on new operating principles. Work of this type is already being conducted and expanded, by the way, at a number of the higher-educational institutions of the country.

The clearest possible formulation of social and economic requirements for technical systems of future generations and a regard for socially permissible necessary expenditures of labor for specific technologies, the time periods for the amortization and substitution of the equipment created, prospects for the development of export potential and a number of other general economic conditions is essential for effective informational modeling. A generally adopted methodology for conducting work of this type has still not taken shape. And it is essential so as to create equipment that is not only better than that existing. It is important that the new machinery satisfy to the fullest the production, social and economic needs that will arise at the instant of their entry into mass exploitation.

In our opinion, the work oriented in this manner should be organized within the framework of the complexes that have been formed in the country--agro-industrial, machine-building, fuel-and-power and the like.

The information centers at the all-union and sectorial levels should be actively included in this work on an equal footing with the leading scientific centers and intersectorial scientific and technical complexes. Principal attention in this should be devoted to the transfer of the technical solutions of one branch of knowledge to another, and especial attention to its transfer through interdepartmental barriers.

Temporary scientific collectives should play their own role in especially crucial situations. It is simplest to coordinate the actions of specialists from the organizations of various departments, the USSR Academy of Sciences, Gosplan, higher-educational institutions and sectors of the national economy within their framework.

Within the Framework of the Five-Year Plan

An evaluation of the level of the technical solutions developed and their documentation are a most important element in the formation of prospective conceptions of the features of the machinery systems and complexes created. GOST [All-Union State Standard] 15.001-73, "The Development and Placement of Products into Production," along with subsequent additions, stipulates that technical requirements be developed (and consequently, evaluated) on the basis of "the results of scientific research and experimental operations, scientific forecasting, an analysis of the leading achievements and the technical level of domestic and foreign equipment and prospective models and systems of machinery, equipment and other technology, the study of patent documentation and, for products intended for export, a regard for the requirements of the foreign market."

Indicators of marketability are of great significance in evaluating the technical documentation at the development stage. (Footnote 1) (Marketability is sometimes unjustifiably equated with indicators of the technical level. This is, however, a narrow interpretation of the given concept, since marketability is determined not only by technical parameters, but by the price of consumption (expenditures for acquisition and utilization).)

It is further indicated that the requirements included in the technical requirements should be based on the modern achievements of science and technology and "the necessity of ensuring advanced indicators of product technical level."

In evaluating specific machinery it should be taken into account that the modern level of equipment reflected in documentation, especially patent documents, is not always able to be described by the features of future equipment projects. This level, as a rule, is determined by something else--the aggregate of the technical solutions. It is namely the scientific and technical potential of the solution that also ensures the advance of the equipment to new frontiers.

Consequently, in an evaluation of the technical level from this point of view, principles similar to those in the scientific and technical expert analysis of inventions are sooner employed, since the necessity arises of comparing the

logical formulas of technical solutions. Unfortunately, we do not yet have at our disposal the appropriate methods for the automation of such procedures.

In this regard, it must be noted that the determination of the technical level reflected in technical solutions already developed cannot be limited to the search for information about those solutions alone. Statistical patent research is far more useful. It is necessary to process large volumes of information for this, however, and in particular data on inventor activities and the patenting of technical solutions. That is, to obtain an evaluation of the trends of scientific and technical thought that can reveal the trajectory of the progressive development of equipment and technology in a certain time frame.

An important tool for the study of technical systems, the development of which is envisaged, for example, by five-year plans, are the yearly survey reports prepared by informational organs at all levels. The condition of these reports, stipulated by GOST 7.38-72, however, does not meet growing requirements. The principal shortcoming is that each informational institute autonomously finds and describes what, in its opinion, is the modern level of development.

It would be more natural if Gosplan or GKNT served as the clients of this work, orienting its executors toward priorities that are really topical for the national economy. VINITI [All-Union Institute of Scientific and Technical Information] of GKNT and the USSR Academy of Sciences could prepare a report on the state and results of functional research, the VNIIPI [All-Union Scientific Research Institute of [expansion unknown]] of Goskomizobreteniy [State Committee for Inventions and Discoveries] could compile a survey of the corresponding new technical solutions, and the VNIIKI [All-Union Scientific Research Institute of Technical Information, Classification and Coding] of Gosstandart could coordinate all of this with the quality requirements of users, while the sectorial organs would analyze the opportunities for the realization of the new solutions. In other words, a systemic organization of the work is needed here as well.

It is probably necessary to entrust the development of criteria for the optimization of requirements for technical projects taking into account the conditions of the formation of machinery systems and complexes to the newly organized VNII [All-Union Scientific Research Institute] of Problems of Machine Building of GKNT. Consideration should also be given to the functional diagnostics of planned machinery and devices as a new section of the technical-planning sphere.

A knowledge of the modern level of equipment is also essential for the selection of the organizational means for achieving the desired goals. The creation of new technical projects is possible in various ways: by means of internal NIOKR, with the aid of the scientific and technical collaboration or production and technological cooperation with foreign partners, via the acquisition of licenses, through imports and by other means.

The method of alternatives analysis preceding the selection of this or that version for the achievement of the assigned technical level has not yet found

widespread application in the practice of the machine-building ministries. This selection still has a quite subjective character. The consequences of this approach have been criticized repeatedly in the press.

Know the Existing Equipment!

The certification of product output accomplished principally according to foreign analogues is the traditional procedure for evaluating the technical level today. This approach, by the way, is far from always justified. In the first place, it ignores the quality of the articles that is economically justified under specific conditions for the national economy; in the second place, competitive conditions, especially in the markets of the developed capitalist countries, gives rise to many distorted phenomena that frequently skew the actual conception of new-equipment features, product mix etc. that are optimal for our conditions.

An orientation toward foreign analogues screens the main thing--the actual requirements of domestic consumers for new equipment. Operational suitability, actual running times per failure, real proportionate consumption of raw materials, fuel and power, the causes of failures, repairability, innovative proposals of operators, the complaints of foreign users and so on and so forth--far from all of these user concerns are known to the designer.

The collection and centralized processing of reports on the quality of product output and an analysis of the complaints made by users are the type of topical information that still must be organized. By the way, the ever more acute necessity is arising for the more active utilization of such information for improving equipment output and the rendering of complaints to the sectors that supply component parts.

As applied to every system or group of machinery, the level of which must be evaluated objectively, it is still necessary to discover the most substantive traits, features and characteristics, first and foremost from the point of view of the user. Only on that basis can an objective representation of the equipment output be created.

Informational Bases of a New Type

The creation of an effective system of informational support for the evaluation procedures of the modern and prospective levels is a vital task. That is why hypothetical models of the equipment of the future are needed for its resolution. That which we called "informational prototypes."

It is apparent that these models can be dynamic structures that change in time and space. Individual characteristics of them can change their meaning: certain traits will lose topicality and others will arise anew.

This signifies that the database containing the necessary information for the expert analysis of the conformity of the features of the equipment that has been created to the required level cannot be anything created and set once and for all.

The most suitable foundation for the formation of these bases, in our opinion, could be the frame structures (see diagram), "fed" by special algorithm from the documentary and factual information-retrieval systems.

Unfortunately, the divergent opinion still exists that any informational task can be resolved by the creation of a database.

But after all, there are databases and databases!

In one case it is enough to put together some collection of the features of a certain ordered number of articles for theoretical "regiments." But it is far from simple to break down the features and particulars of machinery and technologies that cannot be described in parameter form.

This does not signify, however, that traditional methods of evaluating machinery and instruments have lost their topicality. The application of existing factual retrieval systems that contain information on domestic and foreign analogues is productive for the certification of technologically assimilated equipment. This also cannot be handled without the centralized processing of the accompanying documentation for imported equipment.

The development of methods for the formation and functioning of databases for the evaluation of the level of equipment dictates the necessity of uniting the efforts of specialists of the organizations of the USSR Academy of Sciences, GKNT and the leading sectorial centers for machine-building information. Information employed in the practice of the economic management of the technical level must be entered into these databases. It is necessary to include these systems organically in the whole management system of scientific and technical progress, ensuring their coordination with its remaining elements.

By virtue of the especial importance of this class of work and its complexity and labor intensiveness, it should be included in the plan for the national economy as special, state-priority research with the corresponding legal and material and technical support.

Any piece of machinery can be represented in the form of a functional model. The chief function--the machine's designation--is achievable in combination with auxiliary ones (see upper part of diagram).

At the basis of each function is a physical or other effect. It determines the operating principle as well. A set of modules of operating principles corresponds to each function which can have an alternative character (see middle part of diagram). In order to realize the operating principle in a working machine, technical solutions are required (see lower part of diagram). Any operating principle can be accomplished by a specified number of various technical solutions.

Thus, each operating principle creates its corresponding block of technical solutions. The most efficient combination of solutions is chosen by the designer in the creation of new technical projects (as shown in the diagram by the intra- and inter-block arrows).

Accelerating scientific and technical progress requires the reliable selection of the most rational solutions, which is associated with the run-through of a wide circle of alternatives. The frame structure, making it possible to encompass and quantify them, creates the preconditions for the efficient use of econometric models and computers for the pre-plan forecasting of future generations of machinery and systems and complexes of them--with the required features.

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